TENNESSEE DEPARTMENT

OF

ENVIRONMENT AND CONSERVATION

DOE OVERSIGHT DIVISION

ENVIRONMENTAL MONITORING PLAN

JANUARY through DECEMBER 2004

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LIST OF COMMON ACRONYMS AND ABREVIATIONS

ASER	Annual Site Environmental Report (written by DOE)
ASTM	American Society for Testing and Materials
BCK	Bear Creek Kilometer (station location)
BFK	Brushy Fork Creek Kilometer (station location)
BJC	Bechtel Jacobs Company
BMAP	Biological Monitoring and Abatement Program
BNFL	British Nuclear Fuels Limited
BOD	Biological Oxygen Demand
BWXT	Y-12 Prime Contractor (current)
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAP	Citizens Advisory Panel (of LOC)
CCR	Consumer Confidence Report
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
COD	Chemical Oxygen Demand
CPM (cpm)	Counts per Minute
CRM	Clinch River Mile
CROET	Community Reuse Organization of East Tennessee
CWA	Clean Water Act
CYRTF	Coal Yard Runoff Treatment Facility (at ORNL)
D&D	Decontamination and Decommissioning
DOE	Department of Energy
DOE-O	Department of Energy-Oversight Division (TDEC)
DWS	Division of Water Supply (TDEC)
E. coli	Escherichia coli
EAC	Environmental Assistance Center (TDEC)
ED1, ED2, ED3	Economic Development Parcel 1, Parcel 2, and Parcel 3
EFPC	East Fork Poplar Creek
EMC	Environmental Monitoring and Compliance (DOE-O Program)
EMWMF	Environmental Management Waste Management Facility
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera (May flies, Stone flies, Caddis flies)
ERAMS	Environmental Radiation Ambient Monitoring System
ET&I	Equipment Test and Inspection
ETTP	East Tennessee Technology Park
FDA	U.S. Food and Drug Administration
FRMAC	Federal Radiation Monitoring and Assessment Center
g	Gram
GHK	Gum Hollow Branch Kilometer (station location)
GIS	Geographic Information Systems
GPS	Global Positioning System
GW	Ground Water
GWQC	Ground Water Quality Criteria
HAP	Hazardous Air Pollutant
HCK	Hinds Creek Kilometer (station location)
IBI	Index of Biotic Integrity
IC	In Compliance
“ISCO” Sampler	Automatic Water Sampler
IWQP	Integrated Water Quality Program
K-####	Facility at K-25 (ETTP)

LIST OF COMMON ACRONYMS AND ABREVIATIONS CONTINUED

K-25	Oak Ridge Gaseous Diffusion Plant (now called ETTP)
KBL	Knoxville Branch Laboratory
KEAC	Knoxville Environmental Assistance Center
l	Liter
LC_{50}	Lethal Concentration at which 50 % of Test Organisms Die
LMES	Lockheed Martin Energy Systems (past DOE Contractor)
LOC	Local Oversight Committee
LWBR	Lower Watts Bar Reservoir
MARSSIM	Multi-agency Radiation Survey and Site Investigation Manual
MBK	Mill Branch Kilometer (station location)
MCL	Maximum Contaminant Level (for drinking water)
MDC	Minimum Detectable Concentration
MEK	Melton Branch Kilometer (station location)
µg	Microgram
mg	Milligram
MIK	Mitchell Branch Kilometer (station location)
ml	Milliliter
MMES	Martin Marietta Energy Systems (past DOE Contractor)
µmho	Micro mho (mho=1/ohm)
MOU	Memorandum of Understanding
mR	Microroentgen
mrem	1/1000 of a rem – millirem
N, S, E, W	North, South, East, West
NAAQS	National Ambient Air Quality Standards
NAREL	National Air and Radiation Environmental Laboratory
NAT	No Acute Toxicity
NEPA	National Environmental Policy Act
NIC	Not In Compliance
NOAEC	No Observable Adverse Effect Concentration (to Tested Organisms)
NOV	Notice of Violation
NPDES	National Pollution Discharge Elimination System
NRWTF	Non-Radiological Waste Treatment Facility (at ORNL)
NT	Northern Tributary of Bear Creek in Bear Creek Valley
OMI	Operations Management International (runs utilities at ETTP under CROET)
OREIS	Oak Ridge Environmental Information System http://www-oreis.bechteljacobs.org/oreis/help/oreishome.html
ORISE	Oak Ridge Institute for Science and Education
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Association
OSL	Optically Stimulated Luminescent (Dosimeter)
OU	Operable Unit
PACE	Paper, Allied-Industrial, Chemical, and Energy Workers Union
PAM	Perimeter Air Monitor
PCB	Polychlorinated Biphenol
pCi	$1x10^{-12}$ Curie (Picocurie)
PCM	Poplar Creek Mile (station location)
pH	Proportion of Hydrogen Ions (acid vs. base)
PWSID	Potable Water Identification “number”
ppb	Parts per Billion

LIST OF COMMON ACRONYMS AND ABREVIATIONS CONTINUED

ppm	Parts per Million
ppt	Parts per Trillion
PRG	Preliminary Remediation Goals
QA	Quality Assurance
QC	Quality Control
R	Roentgen
RBP	Rapid Bioassessment Program
RCRA	Resource Conservation and Recovery Act
REM (rem)	Roentgen Equivalent Man (unit)
RER	Remediation Effectiveness Report
ROD	Record of Decision
RSE	Remedial Site Evaluation
SLF	Sanitary Landfill
SNS	Spallation Neutron Source
SOP	Standard Operating Procedure
SPOT	Sample Planning and Oversight Team (TDEC)
SS	Surface Spring
STP	Sewage Treatment Plant
SW	Surface Water
TDEC	Tennessee Department of Environment and Conservation
TDS	Total Dissolved Solids
TIE	Toxicity Identification Evaluation
TLD	Thermoluminescent Dosimeter
TOA	Tennessee Oversight Agreement
TRE	Toxicity Reduction Evaluation
TRM	Tennessee River Mile
TRU	Transuranic
TSCA	Toxic Substance Control Act
TSCAI	Toxic Substance Control Act Incinerator
TSS	Total Suspended Solids
TTHM's	Total Trihalomethanes
TVA	Tennessee Valley Authority
TWQC	Tennessee Water Quality Criteria
TWRA	Tennessee Wildlife Resources Agency
U.S.	United States
UT-Battelle	University of Tennessee-Battelle (ORNL Prime Contractor)
VOC	Volatile Organic Compound
WCK	White Oak Creek Kilometer (station location)
WM	Waste Management
WOL	White Oak Lake
X-####	Facility at X-10 (ORNL)
X-10	Oak Ridge National Laboratory
Y-####	Facility at Y-12
Y-12	Y-12 Plant (Area Office)

Introduction

The Tennessee Department of Environment and Conservation, DOE Oversight Division (the division) under terms of the Tennessee Oversight Agreement Section A.7.2.1 is providing an annual environmental monitoring plan for the calendar year 2004. The plan consists of a series of individual work plans describing independent environmental monitoring and surveillance. Oversight of DOE's environmental monitoring and surveillance programs is also described. Chemical and radiological emissions in the air, water, biota, and sediment on the Oak Ridge Reservation and environs are emphasized. The goal is to assure that DOE Oak Ridge Operations has no adverse impact to public health, safety, or the environment. Results from our monitoring and our findings of the quality and effectiveness of the DOE's environmental programs are reported in our quarterly and annual status reports. An annual environmental monitoring report is also provided each spring that details the technical results of these studies.

This plan offers the Department of Energy the opportunity for review and consultation on the division's monitoring activities and to take split samples as needed. For situations such as storm events, non-permitted discharges or spills, we may perform short notice or no notice sampling. DOE will be informed as soon as a decision is made to take short notice or no notice samples. Environmental monitoring is a dynamic process and will periodically change. Major changes to this plan will be made in writing to DOE.

The division or the Tennessee Department of Health, Environmental Laboratory and Microbiological Laboratory Organization (Laboratory Services) will process quantitative chemical samples. Laboratory Services has expertise in a broad scope of services and analysis. Certain analyses and Quality Assurance/Quality Control (QA/QC) samples are subcontracted out by Laboratory Services to independent certified laboratories. Bench level QA/QC records and chain of custody records are maintained by Laboratory Services for all samples collected by the division. The Laboratory Services Standard Operating Procedures are followed and also serve as a guide to the division's laboratory procedures. General sampling and analysis methods follow EPA guidelines.

Benthic macroinvertebrates and other biological samples are taxonomically identified at Laboratory Services or in the division's laboratory. Common water quality measurements and radiological readings are done in the field with calibrated instruments. Environmental dosimeters and radon detectors are analyzed by outside vendors and not Laboratory Services. All work follows EPA, state, and instrument manufacturer's protocols as appropriate. Data loggers are used as available to reduce transcription errors.

Air Quality Monitoring

The division's integrated air quality monitoring is performed to verify and enhance the monitoring of the air quality on the Oak Ridge Reservation, as well as the surrounding areas which may be impacted from DOE Oak Ridge Operations. The division implements EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Air Program. We provide radiological surveillance of ambient air quality in the vicinity of the ORR and compare the results to that of the national ERAMS program. The ORR perimeter program is oversighted. In fact, we have arranged to use DOE's pre-filter media for our own radiological analysis and do direct trend comparisons. Portable samplers are also set up to measure hazardous and radioactive contaminants around DOE demolition and remediation projects. Results are used to verify that DOE keeps contamination

contained during clean-up activities. In the event of a large catastrophic release, any of these data could be used for consequence assessment and to guide recovery efforts, even in the community.

Biological/Fish and Wildlife
The division provides independent biological monitoring and oversight on and off the Oak Ridge Reservation to determine the impact of DOE operations. The division works in conjunction with the Tennessee Wildlife Resources Agency (TWRA), the Tennessee Valley Authority (TVA), and with other Tennessee Department of Environment and Conservation offices to coordinate valley wide monitoring efforts related to fishing advisories. Specific contaminant pathways are investigated on the Oak Ridge Reservation as well. Results are used to formulate recommendations on clean-up and measure potential human and environmental risk. We are currently measuring impacts to aquatic biota, contamination in geese and deer and other indicator species such as lichens and watercress. We also are mapping invasive plants on a 3000-acre conservation easement.

Drinking Water
Public water systems on the Clinch River and Tennessee River can be adversely impacted by DOE activities on the Oak Ridge Reservation. The division's independent drinking water monitoring supports public water system's monitoring efforts related to releases from the Oak Ridge Reservation. The division implements EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Drinking Water Program. Results are compared to the national program. The state provides labor and EPA provides expendables and analysis. Another note, because DOE plant water distribution systems operate at a fraction of historical capacity and can stagnate, we also monitor chlorine residuals in DOE facilities. The comprehensive goal is to document and trend that systems continue to be safe from radiological, chemical, and bacteriological contamination.

Groundwater Monitoring
The division's groundwater monitoring program provides information about Oak Ridge Reservation releases and potential impacts on health and the environment. Given the implications of contaminant transport off the Oak Ridge Reservation via groundwater, the division will continue its emphasis on the identification of groundwater pathways. These activities include monitoring of water supplies, wells, and springs on and off the ORR and hydrogeological investigations such as aquifer evaluations and dye traces. Integration of groundwater and surface water results refine concepts of groundwater behavior. Much groundwater tracing is opportunistic, as we must take advantage of favorable weather or sinkhole discoveries during construction, etc.

Radiological Monitoring
The division's radiological monitoring is directed toward the development of a comprehensive radiological monitoring system as prescribed by the Tennessee Oversight Agreement, Attachment C.2 "Radiological Oversight." The primary focus of the program is the detection of radiological contamination with the potential to impact human health and the environment. Our radiological program contributes in all media areas and reviews CERCLA, NEPA, waste disposition, and other projects involving radionuclides. Autonomous monitoring includes facility surveys, gamma monitoring of the ORR and UF6 yards, footprint reduction surveys, radon monitoring at the Bear Creek Burial Grounds, and real time gamma monitoring around active demolition and remediation sites. Automated gamma monitoring is being done at the Environmental Management Waste

Management Facility in Bear Creek Valley, for example. The DOE weigh scales data base is compared to our gamma monitoring data. Using time stamps to match data, we are monitoring radiation readings on waste shipments delivered for disposal and assuring that radioactive shipments are weighed and documented.

Surface Water Monitoring

The division measures trends in the quality of water and sediments in the Clinch River and Oak Ridge Reservation tributaries. Surface water is one of Tennessee's most important economic and environmental resources but local waterways rarely unconditionally meet all designated uses. For example, there are advisories on fish consumption from local reservoirs and streams. Legacy pollution from DOE, other industries, and non-point source origins are continuing problems. Long term monitoring can define success or failure of clean-up actions, source controls, and attenuation. Specifically, we are analyzing water from Bear Creek to isolate legacy source inputs. It is hoped that the long term monitoring strategy for the new Environmental Management Waste Management Facility can be positively affected and that existing sources/pathways can be found, analytically isolated, trended, and remedied. Indeed, in 2003 we found that excavation of the Boneyard-Burnyard reduced uranium concentrations in a nearby Bear Creek tributary almost immediately. Another perspective, the Clinch and Tennessee Rivers are drinking water sources for several municipalities. Knowing pollutant concentrations has implications for drinking water obtained from surface waters.

Invitation for Public Comment

This plan is published to inform the public about state sampling on the ORR and environs. Any comments from the public on where or how our future sampling should be done are greatly appreciated. Comments can be sent to:

Darlene Seagraves
TDEC DOE-O
761 Emory Valley Road
Oak Ridge TN 37830

Comments can also be sent to darlene.seagraves@state.tn.us or faxed to (865) 482-1835.

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CHAPTER 1 AIR QUALITY MONITORING

Monitoring of Hazardous Air Pollutants at the East Tennessee Technology Park (ETTP)

Introduction

This independent monitoring project is conducted under authority of the Tennessee Oversight Agreement. It is a continuation of the ambient air-monitoring project initiated in 1997 in response to the heightened level of public concern regarding potential impacts to public health from the TSCA Incinerator emissions. Additionally, with the continuation of D&D activities as well as the BNFL metals recovery project at the K-31 and K-33 buildings, further analyses of the potential impacts, if any, of these projects on the ambient air on and around the ETTP site is warranted.

Through use of the division's Hi-Volume ambient air samplers, levels of Arsenic, Beryllium, Cadmium, Chromium, Lead, Nickel and Uranium (as a metal only) in the ambient air at the ETTP site will be determined. The goal of this project will be accomplished through locating samplers at predetermined sampling locations currently in use for the 2003 calendar year monitoring project. These locations have been selected through wind rose data indicating their presence in the prevailing wind flow directions at the ETTP site. The sites are as follows:

- K-2 Blair Rd across from the TSCA Incinerator,
- Station 42/TSCA-1 on Blair Rd, and
- Station 35/TSCA-2 site on Gallaher Rd. (See Figure 1)

Although this project will sample for metals only, the Radiological Monitoring Oversight (RMO) program of the Department of Energy-Oversight Division (TDEC) will continue ongoing radiological ambient air monitoring on the ETTP site.

Methods and Materials

On a weekly basis sample filters will be collected from the sampler and sent for analysis to the state laboratory in Nashville. The sampler will remain at each site for approximately one month before being rotated to the next station. The project will proceed as close as possible in accordance with the following 2004 schedule for station rotation:

January 2004	-	K-2	July 2004	-	K-2
February 2004	-	K-42	August 2004	-	K-42
March 2004	-	K-35	September 2004	-	K-35
April 2004	-	K-2	October 2004	-	K-2
May 2004	-	K-42	November 2004	-	K-42
June 2004	-	K-35	December 2004	-	K-35

Methods and protocols have been developed based on equipment maintenance manuals supplied by the manufacturer and sampling criteria tailored specifically to this project and DOE-O's mission and staffing levels. Each sampler is mounted on a small trailer and requires leveling and the fastening of a security chain when relocated after completion of a sampling cycle.

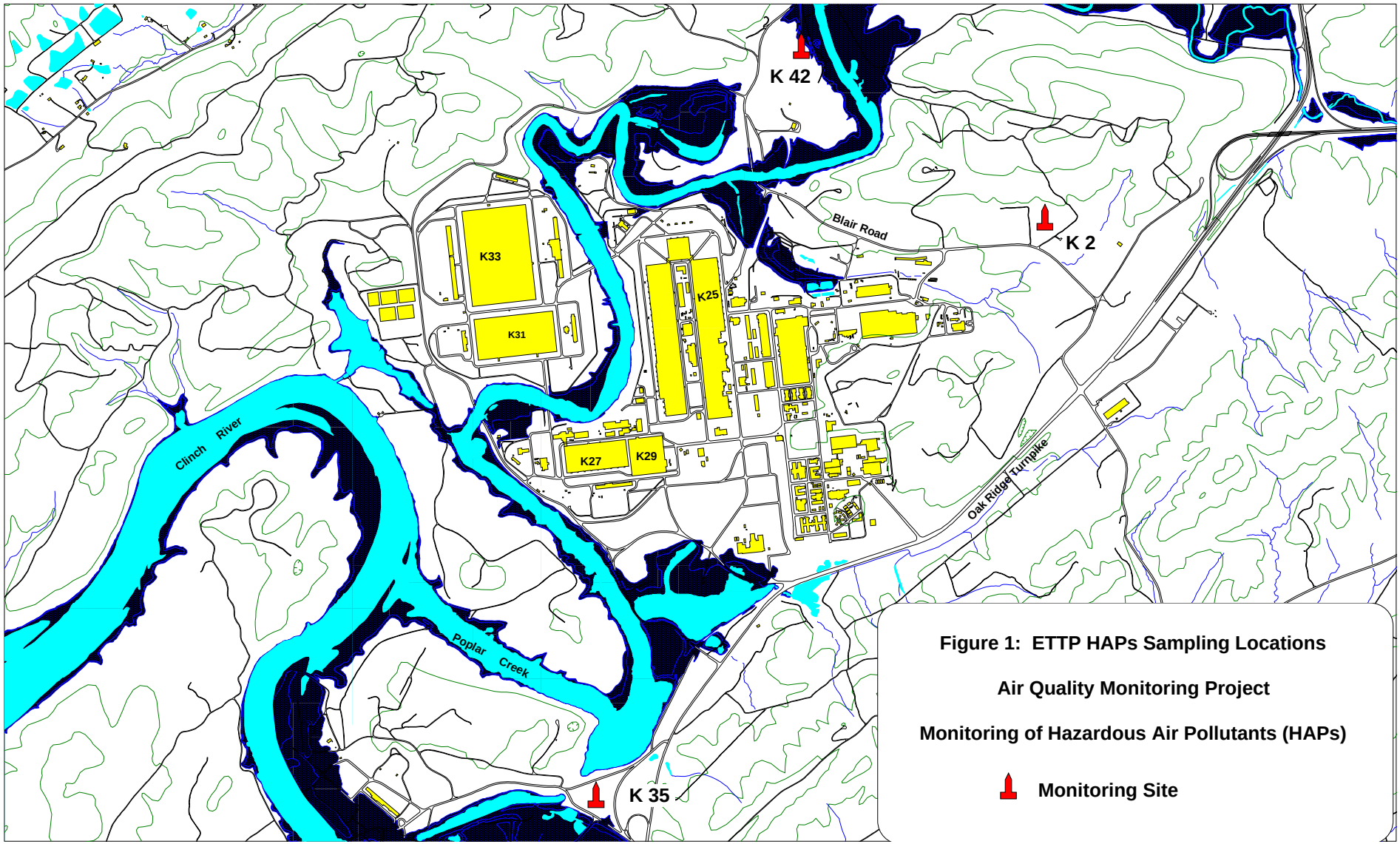

Figure 1: ETTP HAPs Sampling Locations

Air Quality Monitoring Project

Monitoring of Hazardous Air Pollutants (HAPs)

Monitoring Site

During each site visit, the sampler motor will be disassembled and the motor's brushes inspected for condition and evaluated for longevity. When it is not expected that the brushes will last until the next site visit, they will be replaced. The sampler will also be inspected to ensure that the orifice remains level and parallel to the ground. At each site visit the sampling cartridge will be removed and replaced with one holding a new filter. The cartridge will be covered both top and bottom, and the sample will be removed at the DOE-O laboratory and placed in a zip-lock bag. The 24-hour chart recording pressure differential will be removed and replaced weekly and its pen trace will be evaluated for average readings for the weekly period. Relevant information will be recorded on the reverse side of the chart. Readings of atmospheric pressure and ambient temperature are to be recorded on the chart, and the reading of the elapsed time indicator will also be taken. Proper chain of custody for samples will be maintained. DOE-O staff will maintain a quarterly calibration schedule that will be carried out in accordance with the manufacturer's specifications.

A report will be generated detailing the analytical results from each sampling location. Upon completion of the project a final report will be prepared presenting conclusions regarding ambient air HAPs metals.

Materials required for this project include:

1. Hi-Volume sampler
2. Trailer
3. Level
4. Extension cords
5. Tool kit
6. Motor brushes
7. Filters
8. Calibration kit
9. Flow charts
10. Waterproof marking pens
11. Project data/custody forms
12. Plastic sample bags

References

New York State Department of Environment Control, Draft New York State Air Guide-1, Guidelines for the Control of Toxic Ambient Air Contaminants, Appendix B of Air Guide-1, Ambient Air Quality Impact Screening Analyses, 1994 Edition.

Operations Manual for GMW Model2000H Total Suspended Particulate Sampling System, 1998 Graseby GMW Variable Resistance Calibration Kit # G2835.

Tennessee Department of Environment and Conservation, TDEC DOE-O Procedure Number: SOP-ES&H-004 Air Monitoring/Air Sampling.

Tennessee Department of Environment and Conservation, *Tennessee Oversight Agreement, Agreement between the U.S. Department of Energy and the state of Tennessee.* Oak Ridge, Tennessee. 2001.

Title 40 CFR Part 266 Appendix V.Boiler and Industrial Furnace Regulations

Yard, C.R., 2004. *Health, Safety and Security Plan,* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee.

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CHAPTER 1 AIR QUALITY MONITORING

Monitoring of Hazardous Air Pollutants at X-10 and Y-12

Introduction

This independent monitoring project is conducted under authority of the Tennessee Oversight Agreement. It is a continuation of the ambient air-monitoring project initiated in 1998 in response to the public's concern regarding possible health effects resulting from the potential presence of hazardous air pollutants on and around the Oak Ridge Reservation.

Additionally, the continuation of remediation activities at ORNL, and the initiation of D&D activities as well as restart of uranium processing operations at Y-12 National Security Complex, presents an opportunity to further evaluate their impact on the ambient air on and around the these DOE sites.

Through use of the Division's Hi-Volume ambient air samplers, levels of Arsenic, Beryllium, Cadmium, Chromium, Lead, Nickel and Uranium (as a metal only) in the ambient air at the Y-12 National Security Complex and ORNL facilities will be determined. The goal of this project will be accomplished through locating samplers at predetermined sampling locations currently in use for the 2003 calendar year monitoring project. These locations have been selected through wind rose data indicating their presence in the prevailing wind flow directions at each site. The sites are as follows:

- ORNL: X-10E - ERAMS station east of the main entrance to the site
  X-10W - Station No. 3 west of the site (See Figure 1)

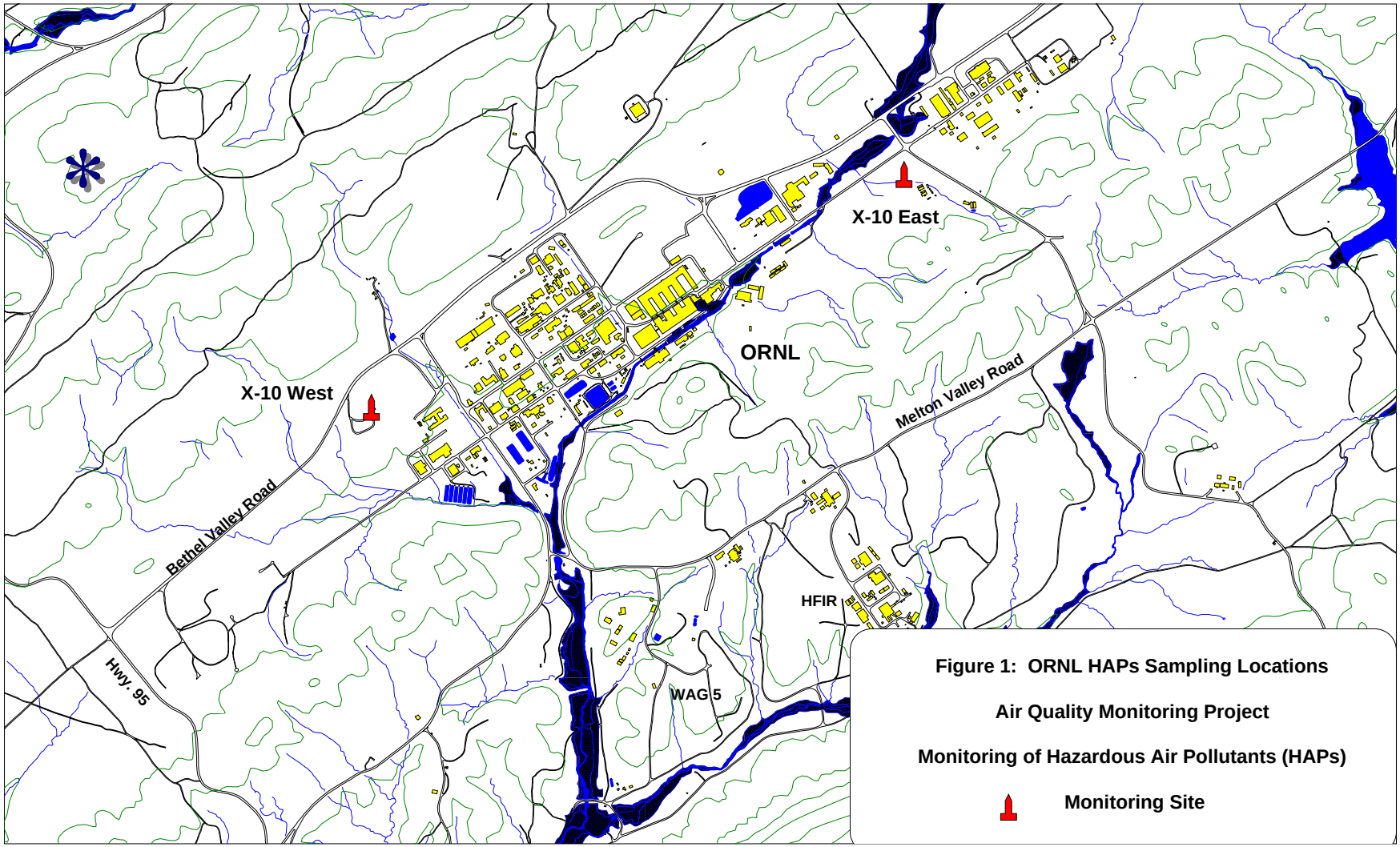
- Y-12: Y-12E - ERAMS station east of the plant entrance
  Y-12W - ERAMS station west of the plant site (See Figure 2)

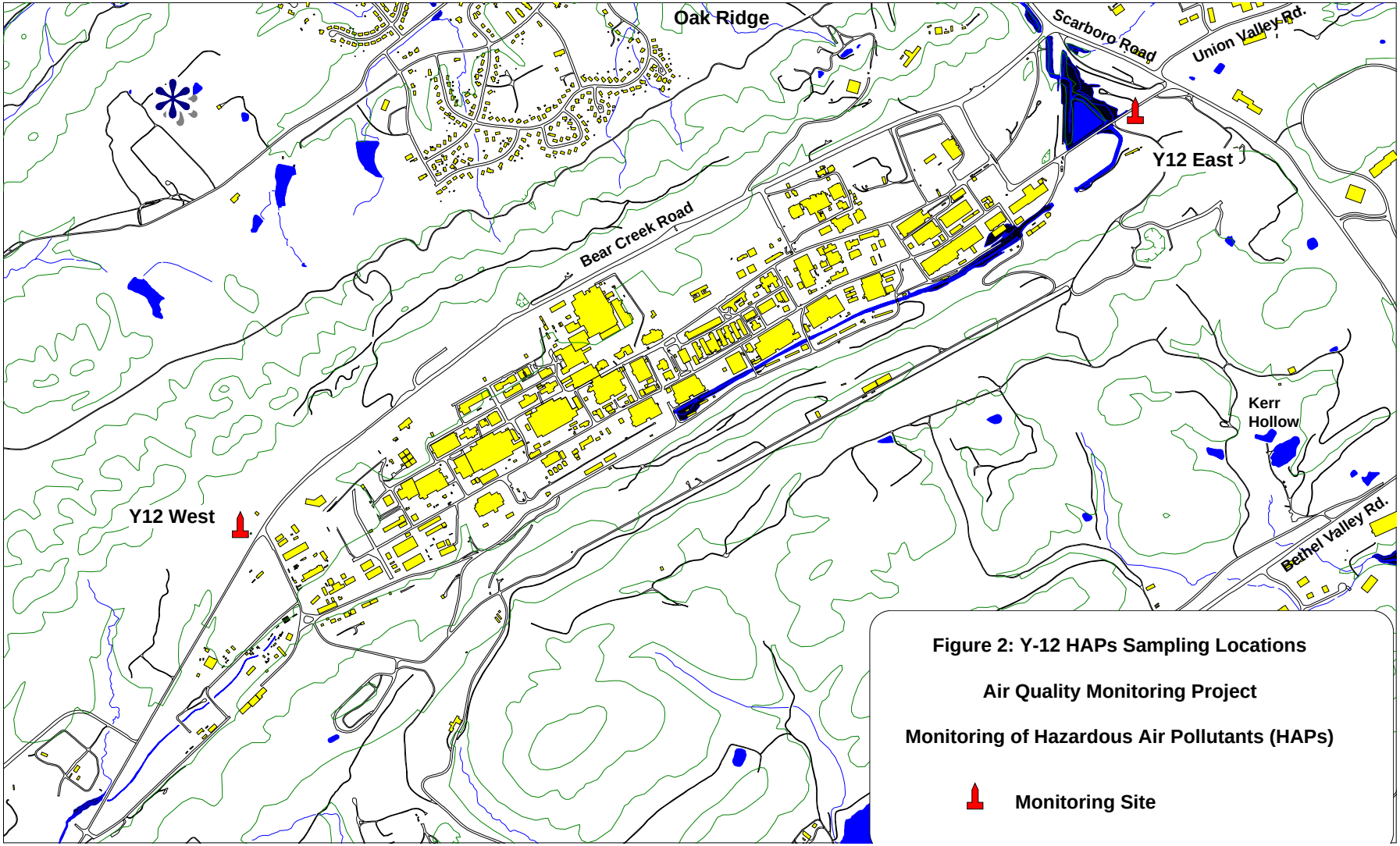
Although this project will sample for metals only, the Radiological Monitoring Oversight (RMO) program of the Department of Energy-Oversight Division (TDEC) will continue ongoing radiological ambient air monitoring on the Oak Ridge Reservation.

Methods and Materials

On a weekly basis, sample filters will be collected from samplers and sent for analysis to the state laboratory in Nashville. Samplers will remain at each site for approximately one month before being rotated to the next station. The project will proceed as close as possible in accordance with the following 2004 schedule for station rotation:

January 2004	-	X-10W & Y-12W	July 2004	-	X-10W & Y-12W
February 2004	-	X-10W & Y-12E	August 2004	-	X-10E & Y-12E
March 2004	-	X-10E & Y-12W	September 2004	-	X-10W & Y-12W
April 2004	-	X-10E & Y-12E	October 2004	-	X-10E & Y-12E
May 2004	-	X-10W & Y-12W	November 2004	-	X-10E & Y-12W
June 2004	-	X-10E & Y-12E	December 2004	-	X-10W & Y-12E


X-10 East
ORNL
X-10 West
Melton Valley Road
Bethel Valley Road
HFIR
Hwy. 95
WAG 5
Figure 1: ORNL HAPs Sampling Locations
Air Quality Monitoring Project
Monitoring of Hazardous Air Pollutants (HAPs)
Monitoring Site


Oak Ridge
Scarboro Road
Union Valley Rd.
Y12 East
Bear Creek Road
Kerr
Hollow
Y12 West
Bethel Valley Rd.
Figure 2: Y-12 HAPs Sampling Locations
Air Quality Monitoring Project
Monitoring of Hazardous Air Pollutants (HAPs)
Monitoring Site

Power supply at the X10E site is provided via a temperature sensitive source. Therefore, during the coldest months, the ORNL sampler will be located at the X10W site. In order to balance time at each location, the ORNL sampler will be located for an extended period of time at the X10E site prior to, and after, this period. Methods and protocols have been developed based on equipment maintenance manuals supplied by the manufacturer and sampling criteria tailored specifically to this project and DOE-O's mission and staffing levels. Each sampler is mounted on a small trailer and requires leveling, and the fastening of a security chain when relocated after completion of a sampling cycle.

During each site visit, the sampler motor will be disassembled and the motor's brushes inspected for condition and evaluated for longevity. When it is not expected that the brushes will last until the next site visit, they will be replaced. The sampler will also be inspected to ensure that the orifice remains level and parallel to the ground. At each site visit the sampling cartridge will be removed and replaced with one holding a new filter. The cartridge will be covered both top and bottom, and the sample will be removed at the DOE-O laboratory and placed in a zip-lock bag. The 24-hour chart recording pressure differential will be removed and replaced weekly, and its' pen trace will be evaluated for average readings for the weekly period. Relevant information will be recorded on the reverse side of the chart. Readings of atmospheric pressure and ambient temperature are to be recorded on the chart, and the reading of the elapsed time indicator will also be taken. Proper chain of custody for samples will be maintained. DOE-O staff will maintain a quarterly calibration schedule that will be carried out in accordance with the manufacturer's specifications.

A report will be generated detailing the analytical results from each sampling location. Upon completion of the project, a final report will be prepared presenting conclusions regarding ambient air HAPs metals.

Materials required for this project include:

1. Hi-Volume sampler
2. Trailer
3. Level
4. Extension cords
5. Tool kit
6. Motor brushes
7. Filters
8. Calibration kit
9. Flow charts
10. Waterproof marking pens
11. Project data/custody forms
12. Plastic sample bags

References

New York State Department of Environment Control, Draft New York State Air Guide-1, Guidelines for the Control of Toxic Ambient Air Contaminants, Appendix B of Air Guide-1, Ambient Air Quality Impact Screening Analyses, 1994 Edition.

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CHAPTER 1 AIR QUALITY MONITORING

Environmental Radiation Ambient Monitoring System (ERAMS) Air Program

Introduction

In the past, air emissions as a consequence of Department of Energy (DOE) activities on the Oak Ridge Reservation (ORR) have been believed to be a potential cause of illnesses affecting area residents. Health concerns due to air and water were of such magnitude, that a five year study 1994-1999 was conducted culminating in a multiple-volume report known as the *Oak Ridge Dose Reconstruction Project Summary Report (2000).* More recently, concerns about health effects from the TSCA incinerator resulted in a June, 1997 task force investigation. While these emissions have substantially decreased over the years with the decommissioning of various processes, concerns have remained that air emissions from current activities may pose a threat to the health of the public and/or the surrounding environment. As a consequence of the above, the Tennessee Department of Environment and Conservation DOE Oversight Division (the division) has implemented three air monitoring programs to assess the impact of ORR air emissions on the surrounding environment and the effectiveness of DOE controls and monitoring systems.

The division's Perimeter and Fugitive Air Monitoring Programs focus on monitoring at exit pathways, non-point sources of emissions, and sites of special interest (e.g., remedial sites). Division participation in EPA's Environmental Radiation Ambient Monitoring System (ERAMS) supplements the other programs and provides verification of state and DOE monitoring, via independent third party analysis. In the Oak Ridge ERAMS program, EPA provides radiochemical analysis of air samples taken twice weekly by division staff at five monitoring stations located on the ORR. Results from this analysis are provided to the division and published by EPA in a quarterly report titled *Environmental Radiation Data*. This publication is currently available on the internet (http://www.epa.gov/narel/erams/).

Methods and Materials

The five ERAMS air monitors will use synthetic fiber filters (ten centimeters in diameter) to collect airborne particulate moving through the units. The monitors will be operated continuously and filters will be changed twice weekly (Monday and Thursday) by division staff. The airflow through each unit will be recorded during the filter change. As prescribed in *Environmental Radiation Ambient Monitoring System (ERAMS) Manual* (U.S. EPA, 1988), the quantity of radioactivity on each filter will be estimated by staff using one of the division's Geiger-Mueller radiation detectors. The filters will then be mailed to EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama for analysis. Analytical parameters are provided in Table 1.

Table 1: EPA Analysis of Air Samples Taken in Association with the Environmental Radiation Ambient Monitoring System

ANALYSIS	FREQUENCY
Gross Beta	Each of twice weekly samples
Gamma Scan	Samples having > 1 pCi/m^3 of gross beta
Plutonium-238, Plutonium-239, Plutonium-240, Uranium-234, Uranium-235, Uranium-238	Semiannually on composite air particulate filters

The approximate locations of the five ERAMS air-monitoring stations are depicted in Figure 1.

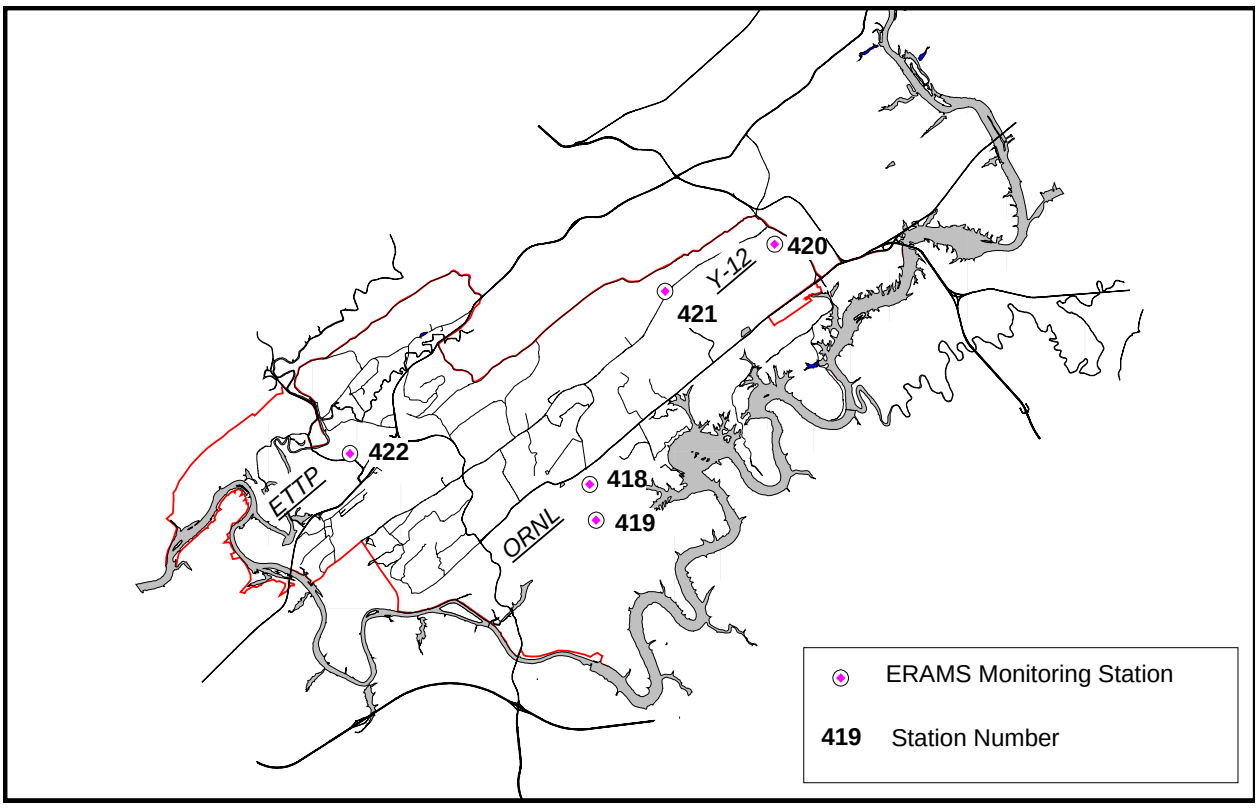

Figure 1: Approximate Locations of Air Stations Monitored in Association with EPA's Environmental Radiation Ambient Monitoring System (ERAMS) on the Oak Ridge Reservation

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Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement, Agreement between the U.S. Department of Energy and the State of Tennessee.* Oak Ridge, Tennessee. 2001.

U.S. EPA. 1988. *Environmental Radiation Ambient Monitoring System (ERAMS) Manual.* EPA 520/5-84-007, 008, 009. May, 1988.

U.S. EPA. 1994. *Environmental Radiation Data Report 80*. EPA-402-R-97-004. February, 1997.

Yard, C.R., 2004. *Health, Safety, and Security Plan.* Tennessee Department of Environment and Conservation, DOE-Oversight Division. Oak Ridge, Tennessee.

CHAPTER 1 AIR QUALITY MONITORING

Fugitive Radiological Emission Monitoring

Introduction

The Tennessee Department of Environment and Conservation DOE Oversight Division (the division), with the cooperation of the Department of Energy and its contractors, conducts monitoring for fugitive radioactive air emissions on and in the vicinity of the Oak Ridge Reservation. This program uses portable high volume air monitor(s) to supplement air sampling performed at fixed locations. In addition to mobility, the high volume monitor(s), along with more frequent sampling and analysis, provides greater measurement sensitivity and resolution than can be achieved with the monitors used in the division's Perimeter Air Program. Monitoring performed with the portable unit(s) primarily focuses on nonpoint sources of air emissions and sites of special interest (e.g., sites under remediation). Should the need arise, the portable unit(s) also provide a means to monitor specific areas under emergency conditions.

Methods and Materials

The division currently uses two high volume air monitors in the program. Staff are attempting to acquire a third monitor for the program in 2004. One of the monitors will be stationed at Fort Loudoun Dam in Loudon County to collect background data. The other unit(s) will be moved to the various areas of interest. Each of the monitors will use 8x10 inch glass fiber filters to collect particulates as air moves through the systems. Components of the monitors used to measure airflow through the filters will be calibrated quarterly using a Graseby General Metal Works Variable Resistance Calibration Kit (#G2835). Air filters from the units will be collected weekly and shipped to the state's radiochemical laboratory in Nashville, Tennessee, for analysis. Analysis will include gross alpha, gross beta, and gamma spectrometry. Additional analysis may be performed, if warranted. Results from the portable monitor(s) will be compared with the background data and standards provided in the Clean Air Act.

Monitoring in the program is directed toward locations where there is a potential for the release of fugitive/diffuse emissions as a consequence of remedial or waste management activities (e.g., excavation of contaminated soils/sediments, demolition of contaminated buildings) and sites of special interest (e.g., the Toxic Substance Control Act Incinerator). As these locations change routinely, specific monitoring stations for the year 2004 are yet to be determined. Sites under consideration include facilities being renovated as part of the revitalization initiative at ORNL, Y12 D&D activities, a location near the construction of the Spallation Neutron Source Facility, a site adjacent to the Environmental Management Waste Management Facility in Bear Creek Valley, and a location adjacent to the K31 and K-33 Process Buildings at ETTP.

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CHAPTER 1 AIR QUALITY MONITORING

Oak Ridge Reservation Perimeter Ambient Air Monitoring Program

Introduction

The Tennessee Department of Environment and Conservation, DOE Oversight Division (the division) with the cooperation of DOE provides radiochemical analysis of air samples taken from twelve low volume air monitors located on and in the vicinity of the Oak Ridge Reservation (ORR). Data derived from the program, along with information generated by the other division air monitoring programs, are used to: (1) assess the impact of DOE activities on the public health and environment, (2) identify and characterize unplanned releases, (3) establish trends in air quality, and (4) verify data generated by DOE and its contractors.

Methods and Materials

The twelve air monitors used in the program are owned by DOE and DOE contractors are responsible for their maintenance and calibration. Nine of the units are a component of DOE's ORR perimeter air monitoring system. The remaining three monitors were previously used by the Y-12 complex in their perimeter air monitoring program.

Each of the monitors use forty-seven millimeter borosilicate glass fiber filters to collect particulates as air is pulled through the units. The ORR perimeter monitors employ a pump and flow controller to maintain airflow through the filters at approximately two standard cubic feet per minute. The Y-12 monitors use a pump and rotometer and are set to average approximately two standard cubic feet per minute.

Air filters from the monitors are collected biweekly and sent by certified mail to the state's radiochemical laboratory in Nashville, Tennessee for analysis. Analysis includes gross alpha and gross beta on the biweekly samples. Gamma spectrometry is performed on samples that exhibit elevated gross results and annually on composite samples.

The twelve air monitoring stations used in the program are listed in Table 1. Eleven of these stations are located around the perimeter of the ORR and Y-12 facility. The twelfth site is the background station located near Fort Loudoun Dam in Loudon County.

Table 1: Perimeter Air Monitoring Stations.

Station	Location	County
4	Y-12 Perimeter near portal 2	Anderson
5	Y-12 Perimeter near Building 9212	Anderson
8	Y-12 Perimeter west end	Anderson
35	East Tennessee Technology Park	Roane
37	Bear Creek at Y-12	Roane
38	Westwood Community	Roane
39	Cesium Fields at Oak Ridge National Laboratory	Roane
40	Y-12 East	Anderson
42	East Tennessee Technology Park off Blair Road	Roane
46	Scarboro Community	Anderson
48	Deer Check Station on Bethel Valley Road	Anderson
52	Fort Loudoun Dam (Background Station)	Loudon

Figure 1 depicts the approximate locations of the monitoring stations.

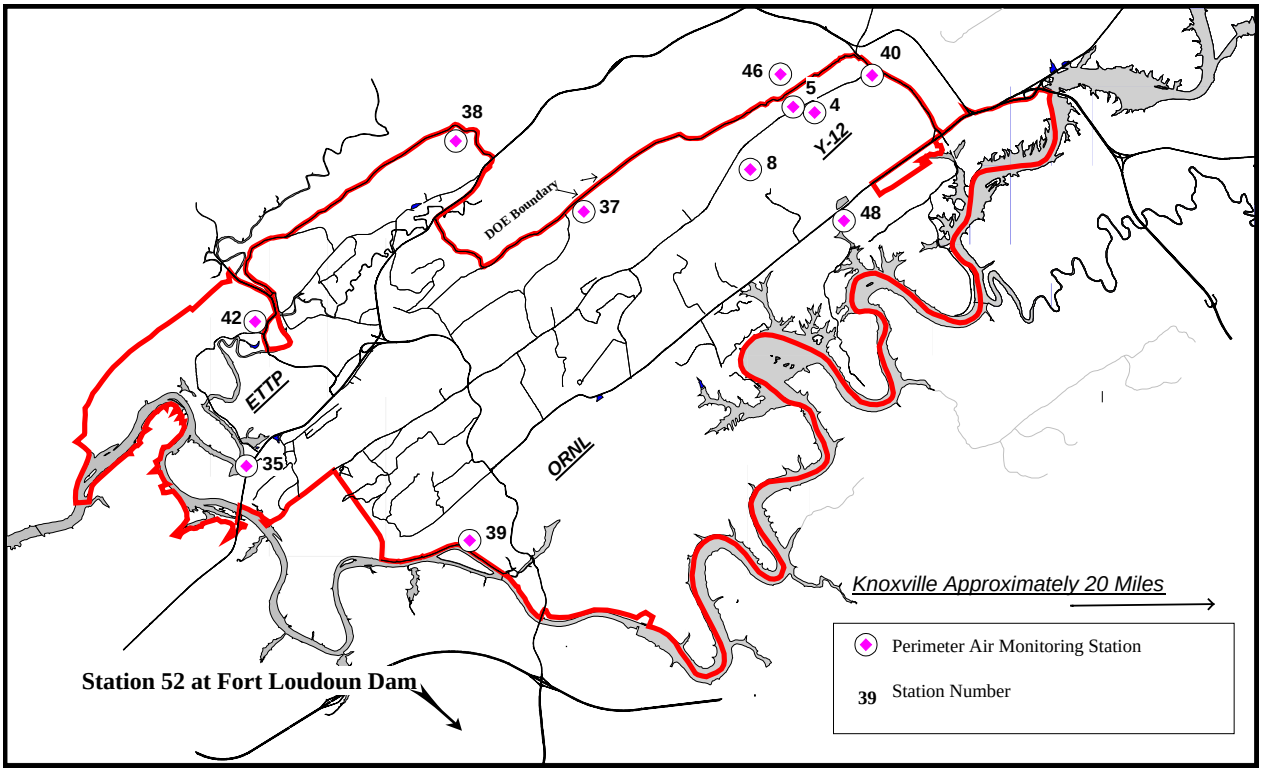

Figure 1: Approximate Location of Oak Ridge Reservation and Y-12 Perimeter Air Monitoring Stations

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CHAPTER 2 BIOLOGICAL/FISH AND WILDLIFE

Benthic Macroinvertebrate Biomonitoring Using a Semi-Quantitative Approach: Rapid Bioassessment Protocol (RBP III)

Project Description

The objective of this monitoring program is to perform biological monitoring on streams effected by activities and practices on the Oak Ridge Reservation (ORR) using methods outlined in the *State of Tennessee Department of Environment and Conservation (TDEC) Division of Water Pollution Control (WPC) Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys* (March 2002).

Introduction

Because benthic macroinvertebrates are relatively sedentary and long lived, they are excellent indicators of the "overall health" of an aquatic system. In systems where the source of the toxicant is non-point (e.g. runoff or seeps) or where the combined effects of pollutants in a complex effluent exceed individual toxicity (synergism), benthic macroinvertebrate communities may be one of the only means of evaluation.

Benthic macroinvertebrates are collected on various ORR streams and analyzed to independently assess the "overall health" of the aquatic environments and to measure the degree of impact from past and present DOE operations. The division conducts annual semi-quantitative RBP III biomonitoring on the following ORR streams: Bear Creek, Mitchell Branch, White Oak Creek, Melton Branch, and East Fork Poplar Creek. Through 2003, background samples were taken in the following reference streams: Gum Hollow and Mill Branch (for Bear Creek), Upper Mitchell Branch and Upper White Oak Creek near SNS, both sites being upstream of any potential impacts, and Brushy Fork Creek and Hinds Creek (for East Fork Poplar Creek). Beginning in 2004, benthic macroinvertebrate sampling will cease at Gum Hollow and Brushy Fork Creek due to repetitive reference sampling for Bear Creek and East Fork Poplar Creek. The sampling sites located at Melton Branch kilometer 0.3 (MEK 0.3) and White Oak Creek kilometer 2.9 (WCK 2.9) will be relocated. MEK 0.3 lies within the section of Melton Branch that will be altered by the Melton Branch Relocation project and will no longer exist. The new site will be moved upstream of MEK 0.3. WCK 2.9 has experienced habitat changes and no longer provides suitable riffles for benthic sampling. A new sampling site upstream of WCK 2.9 will be chosen at a later date. This new site should document impacts from the remediation work being conducted adjacent to the stream. Any future impacts such as groundwater seepage and sheet runoff after the pits and trenches have been capped should also be captured through changes in the biological condition of the stream. Benthic sampling will continue at Clear Creek near Norris Dam serving as an ecoregion reference site for all ORR test sites.

Surface water samples will be collected semi-annually at all sites and will complement the macroinvertebrate sampling. Water samples will be transported to the Tennessee state laboratory in Knoxville and analyzed for bacteria, nitrates, hardness, metals, mercury, and radionuclide constituents (Table 1). Sulfates will also be analyzed in East Fork Poplar Creek and Hinds Creek. EPA approved methods will be used for the collection of the water samples. All work associated with this program will be in compliance with the division's Health, Safety, and Security Plan.

Methods and Materials

Benthic macroinvertebrate samples will be collected and processed following TDEC WPC standard operating procedures (SOP). Briefly, samples will be collected from two riffles at each site with the use of a kick net. Both samples will be composited and transferred into one sample container. The container will be labeled internally and externally with site specific information and stored in the TDEC DOE-O laboratory for future processing. Standard methods will be altered when sampling lower White Oak Creek due to the presence of radioactive contamination in the stream sediment. The two kick samples will be combined in a 5-gallon bucket, creek water is then added and the sample swirled to suspend the lighter material (invertebrates). The elutriate will then be poured through a sieve. This process will be repeated five times collecting the majority of organisms. Any material not used will be returned to the creek. Detailed sampling procedures can be obtained by referring to the TDEC WPC SOP.

Once collections have occurred at all sites the samples will be transported to the state laboratory in Nashville for processing. Laboratory sample analysis will include the identification and enumeration of the benthic macroinvertebrates and data reduction. Using the raw benthic data from the semi-quantitative subsamples, a numerical value will be generated for seven biometrics. These metrics include (1) EPT (Ephemeroptera, Plecoptera, and Trichoptera) Richness, (2) Taxa Richness, (3) Percent OC (oligochaetes and chironomids), (4) Percent EPT (EPT abundance), (5) NCBI (North Carolina Biotic Index), (6) Percent Dominant (Percent contribution of the single most dominant taxon) and (7) Percent Clingers (Percent contribution of organisms that build fixed retreats or have adaptations to attach to surfaces in flowing waters). After values have been calculated for the metrics, a score of 0, 2, 4 or 6 is assigned to each metric based on comparison to the ecoregion reference database. The seven scores are totaled and the site's biological condition is determined. Metric equations and the biocriteria used to determine biological condition can be obtained by referring to the TDEC WPC SOP.

Schedule and sampling locations in kilometers (mile equivalents) for RBP III sites:

East Fork Poplar Creek: EFK 24.4 (15.2), EFK 23.4 (14.5), EFK 13.8 (8.6) and EFK 6.3 (3.9). Reference site: Hinds Creek HCK 20.6 (12.8). All sites will be sampled within a three day time span in April or May.

Bear Creek: BCK 12.3 (7.6) and BCK 9.6 (6.0).
Reference site: Mill Branch MBK 1.6 (1.0). All sites will be sampled within a three day time span in April or May.

Mitchell Branch Creek: MIK 0.71 (0.44) and MIK 0.45 (0.28).
Reference sites: MIK 1.43 (0.89). All sites will be sampled during a three day time span in April or May.

White Oak Creek: WCK 2.3 (1.4) and WCK 3.9 (2.4).
Reference site: WCK 6.8 (4.2). The sites replacing WCK 2.9 and MEK 0.3 will be chosen at a later date. All sites will be sampled during a three day time span in April or May.

Clear Creek: CCK 1.45 (ecoregion reference site). This site will be sampled in April or May.

Table 1. List of Analytes for Surface Water Samples

Enterrococcus	Chromium
Dissolved Residue	Copper
nitrogen, NO_2, NO_3, & ammonia	Iron
Suspended Residue	Lead
total Kjeldahl nitrogen	Manganese
total phosphorus	Mercury
Hardness, total, as $CaCO_3$	Zinc
Arsenic	gross alpha & beta
Cadmium	Gamma Spec
E. Coli	Sulfates (East Fork Poplar Creek only)

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CHAPTER 2 BIOLOGICAL/FISH AND WILDLIFE

Fish Tissue Monitoring Plan

Introduction

The Tennessee Department of Environment and Conservation posts warning signs on streams or lakes in which public health is endangered. In Tennessee, the most common reasons for a river or lake to be posted are the presence of sewage bacteria or other contaminants in the water, sediment, or fish of a waterbody.

When fish tissue samples show levels of a contaminant higher than established criteria, the waterbody is posted and the public is advised of the danger. If needed, TWRA can enforce a fishing ban. Approximately 84,100 lake acres and 142 river miles across the state are currently posted due to contaminated fish. When the department issues new advisories, signs are placed at significant public access points and a press release is submitted to local newspapers.

The Tennessee Valley Authority (TVA) conducts an annual Community Assessment Project to evaluate the condition of the reservoirs in the Tennessee River Valley. The DOE Oversight Division will acquire fish from TVA at several locations around the ORR during the annual Community Assessment Project in order to compare results with those from other agencies and organizations. Tissue samples from these fish will then be analyzed for contaminants of concern.

Methods and Materials

TVA will collect fish at four locations around the ORR. Five largemouth bass of at least one pound each, depending upon availability, from each location will be acquired and samples of tissue analyzed by the state laboratory in Nashville. Since the collection of striped bass is very difficult during the fall, the expectation is that all fish used for analysis will be largemouth bass. A homogenized composite sample from each site will be analyzed for PCBs.

The current state of Tennessee fish tissue advisory criteria is:

Contaminant	Level (ppm)
PCBs	1.00

Locations to be sampled will correspond to locations of the TVA Black Bass Survey. These sites have yet to be determined.

Sampling is scheduled to take place during spring 2004.

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CHAPTER 2 BIOLOGICAL/FISH AND WILDLIFE

Canada Geese Monitoring Plan

Introduction

A large population of Canada geese, both resident and transient, visits the Oak Ridge Reservation (ORR). While migratory geese have always visited East Tennessee, Tennessee Valley Authority (TVA) and Tennessee Wildlife Resources Agency (TWRA) introduced the resident population to the Melton Hill region in 1972. Geese prefer to eat grass, but will also eat water plants including root nodules from bottom sediment. Studies in the 1980s demonstrated that geese associated with the contaminated ponds/lakes on the ORR can accumulate radioactive contaminants quickly and that contaminated geese frequent off site locations. The thriving goose population in this area makes this animal an easily accessible food for area residents. Although hunters are offered the opportunity for a radiological screening of their kills, not many take advantage of this service (TWRA, personnel communication). Results of Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division) off-site sampling in 1999 showed no elevated levels of radioactivity in the geese sampled. Similarly, all geese captured during the Department of Energy (DOE) 1999, 2000, and 2001 "goose roundup" were below the 5 pCi/g game confiscation level, which DOE Oak Ridge has set as an administrative guideline. During the 2002 "goose roundup," three geese were captured from ONRL that had Cs-137 levels above the 5 pCi/g game confiscation level. Geese subsequently captured in offsite sampling at the Oak Ridge Marina showed no Cs-137 or other contamination above the confiscation level. During the 2003 "goose roundup," all geese sampled were below the 5 pCi/g game confiscation level.

Geese with elevated levels of Cs-137 in muscle tissue have been found primarily in areas near ORNL. A study in September 1998 found elevated levels of Cs-137 in grass and sediment at two reaches of White Oak Creek south of 3513 Pond and in grass around the 3524 pond. Sediment in and around White Oak Lake (WOL) and White Oak Creek have elevated levels of Cs-137. Canada geese have been observed on WOL and throughout the ORNL area. After a flock of radioactive geese was found at ORNL in 1998, DOE took several measures to discourage the geese from using and feeding in contaminated areas. Flagging and fencing were improved and several areas were defoliated. These measures appear to have been successful, with no significantly contaminated geese being captured on or off the reservation in 1999 through 2001. State geese sampling would only take place, if any of the geese captured in the Year 2004 DOE "goose roundup" showed significantly elevated levels of radioactivity (above 5 pCi/g). This would indicate the possibility of radioactively contaminated geese leaving the reservation.

Methods and Materials

During the week preceding the goose roundup, areas around the perimeters of the ORR will be scouted to identify locations of possible populations of geese. This will facilitate activities on the day of collection by predetermining likely locations to sample.

Sampling would take place immediately after the annual *ORR Goose Roundup* with equipment and assistance from TWRA and ORNL. Geese are molting at this time of year and are nearly flightless. Sampling would take place over a one to two day period. Variables such as flock location and ease of capture will affect the schedule.

The site selected should be near contaminated vegetation, water, and sediment. An optimum site is the Jones Island area in Loudon County. Geese from this area have access to White Oak Lake and other contaminated ORNL sites. Due to recent movements of populations, the most likely locations will be the Oak Ridge Marina and the Solway Park areas.

Geese would be captured using the same technique as the DOE goose roundup. Eight to fifteen people would slowly converge on a flock of geese forcing them into a temporary enclosure consisting of chicken wire and reinforcing bar. At least 15 individual geese would be captured to assure accuracy of the reading and a representative sample of the flock. Geese would be transported in cages to the TWRA check station for weighing, sexing, and a whole body count. All activities would be carried out in compliance with the division's Health, Safety, and Security Plan (2002).

Results of the whole body count would determine the necessity for further analysis of the geese. If the whole body counts showed the radioactive contamination of the geese to be 5 pCi/g or greater, muscle tissue from the contaminated geese will be radiologically analyzed to confirm the results of the whole body counts and to determine if other contaminants are present. Additional analyses would be for cesium-137, mercury, cadmium, selenium, and lead in the breast and/or leg tissue of geese with whole body counts above 5 pCi/g. Up to six geese (two high, two medium, and two low whole body counts) would be analyzed from a contaminated flock.

Most material will be provided by TWRA. This includes:

- Fencing
- Cages
- Tags

The whole body counters are the property of ORNL and would be operated by their personnel.

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CHAPTER 2 BIOLOGICAL/FISH AND WILDLIFE

Field Mapping of Invasive/Native Plant Species on Blackoak Ridge/McKinney Ridge – 3000 Acre NRDA Conservation Easement

Introduction

During 2003, public meetings (including local advocacy groups) were held for the purpose of inviting the community to comment on the management plan for approximately 3,000 acres (see Figure 1) of federally-owned land on the Blackoak Ridge/McKinney Ridge areas of the Oak Ridge Reservation (ORR). This acreage has been proposed for inclusion in a conservation easement between the state of Tennessee and the Department of Energy pursuant to the Natural Resources Damages Assessment (NRDA) as partial repayment for land resource damages incurred due to federal activities on the ORR. Some comments received advocated managing the site as a natural area. Prior to these events, TDEC and DOE signed a "Letter of Intent" on December 20, 2002, indicating that the area would be managed for conservation, research, and recreation. This conservation easement has been established by DOE pursuant to CERCLA (Superfund) as partial mitigation of natural resource damages (injuries) to the Clinch River and Watts Bar Reservoir. The agreement is not yet finalized as various agenda items remain to be completed (such as the final boundary outline, etc.). The area has been previously surveyed for vascular plants by DOE subcontractors but some sections or habitats could have been missed. Accordingly, the division decided to utilize time in the interim to do an invasive/native plant species survey to more completely document the value of resources of this easement parcel. Therefore, field work commenced in August 2003 (unrelated cursory field surveys had been done in 2002-03) and halted in late October 2003. Resumption of field mapping activities will commence in the Spring of 2004 (mid-March). This project will incorporate the division's role of environmental surveillance.

Methods and Materials

In a large sense, this invasive/native plant survey will be a multi-faceted biodiversity, geological, and historical field study. Field mapping of native and invasive plant species on the 3000 acres will begin by first surveying the available roads and trails with individual field stations (mini-plots) at 100/200 meter intervals as needed. Unusual or rare plants will be located and mapped, if found between these intervals. Once roads and trails are mapped, then transects will be walked cross-country (similar to a "timber cruise") in generally north to south traverses. Later, if feasible, east-west traverses may be done to complete a grid pattern of coverage over the parcel. Selected habitats such as small drainage ravines/floodplains, wetlands, subwatersheds, sinkholes, springs, caves, etc. will be located and mapped.

Each field station (mini-plot) will be mapped using a Global Positioning System (GPS) hand-held field unit. Each field station will be defined as a 50-foot circle from center point or circumference (GPS location being the center point). As many plant species as possible within that 50-foot circle will be identified (common names & corresponding scientific names). This will include the canopy, subcanopy, shrub, herb, and groundcover plant species. Ultimately, several permanent plots will be established throughout the parcel to monitor and list plant species in considerable detail (by layer – canopy, subcanopy, shrub, etc.). The digital camera will be used to document plant species as well as pre-Manhattan cultural/historical features of the former Wheat community. Karst and geologic features such as springs, seeps, sinkholes, and caves will be logged and located with the GPS. If, by chance, any legacy waste (drums, trenches, etc.) or obvious signs of federal activity were to be observed in the backcountry, then these sites will be located and duly reported to DOE as well. Animal species

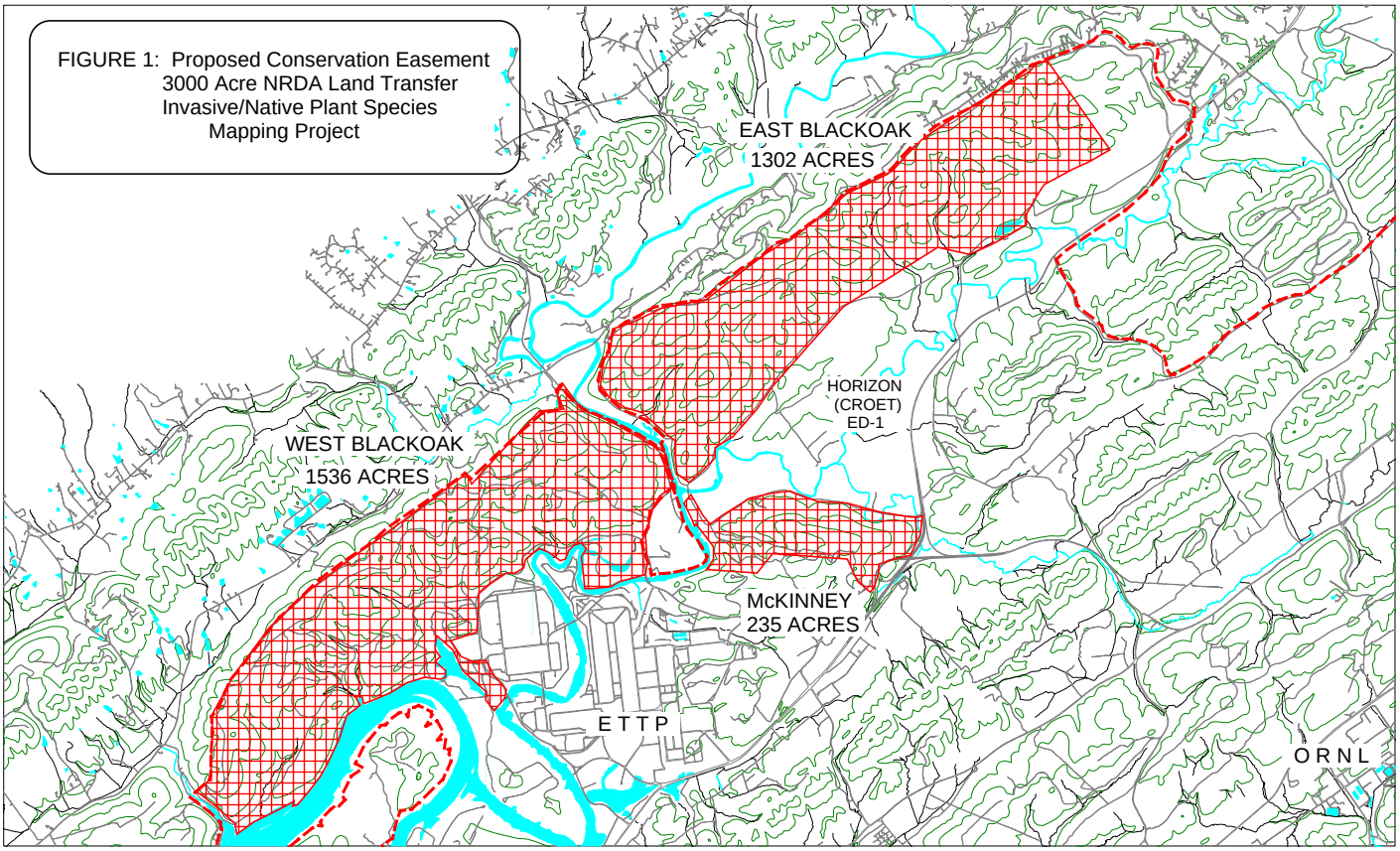
sightings will also be noted. The boundaries of the pine deadfall areas will be mapped whenever possible in the field. These sites may become important ecological study areas to determine if native climax species or invasives will re-establish here.

No analytical sampling of plant species is envisioned for this project. However, plant species will be collected for preservation of herbarium specimens. The sample will be collected as much as possible with either flower or fruit, then pressed and dried, and mounted on herbarium paper with appropriate identification labels. These are quite useful for training purposes but more importantly to document plant species encountered in the field.

Field data sheets (field survey logs) will be recorded for each field station and later placed on an Excel spreadsheet database. Maps will be prepared with MapInfo to show locations of all field stations, geologic features and other pertinent topographical information. Ultimately, plant species maps will be generated to show locations of the major exotic infestation sites.

Sampling protocol and quality control methods will follow the guidelines in the division's "Standard Operating Procedures" and "Health, Safety, and Security Plan."

FIGURE 1: 3000 ACRE PROPOSED CONSERVATION EASEMENT LAND GRANT



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CHAPTER 2 BIOLOGICAL/FISH AND WILDLIFE

Monitoring and Sampling of Aquatic and Terrestrial Plants in Surface Water and Ecological Habitats on the ORR

Introduction

The gathering of collateral information in support of the division's groundwater monitoring and sampling efforts of springs and surface water will be a priority of this project. If surface water bodies (i.e., springs, ponds) have been impacted by hazardous substances, it is likely that the aquatic plant organisms in the immediate vicinity could be uptaking radionuclides or other hazardous substances. The focus of this plan/program will be the detection and characterization of hazardous substances bioaccumulated by both aquatic and terrestrial vegetation to determine ecological and human health risk factors. New for 2004 will be the sampling of periphyton in Upper East Fork Poplar Creek (UEFPC) to determine taxonomy and systematics of green algae (i.e., diatoms) for the classification of these plants to the family and/or genus level. This will be done in cooperation with ORNL staff involved with periphyton assessments of UEFPC (BMAP – Biological Monitoring and Abatement Program).

Expanded target vegetation examples for sampling will include (but not be limited to): 1) watercress; 2) green algae (*Ulothrix, Spirogyra, Oedogonium*, etc.); 3) periphyton (benthic algae - see discussion below); 4) mosses (Bryophyta); 5) liverworts (Hepatophyta); 6) horsetail and quillworts (*Equisetum and Isoetes*); 7) floating & attached aquatic plants (*Azolla, Lemna, Wolffia, Salvinia*); 8) club moss (*Huperzia sp*.); and 9) lichens (*Cladina sp*. and *Cladonia sp.)*. These plant species have been selected because they are excellent bioindicators. These plants are remarkably sensitive to pollution, radioactive fallout, and other hazardous substances (pathogens, i.e., chemicals, metals, etc.). They are known to be ingested by aquatic organisms and herbivores.

Watercress, a floating, rooted, aquatic plant (angiosperm) has been selected for its affinity to thrive around its natural habitat, in clear slow-moving water near the mouth of springs. If the spring water is impacted, then aquatic plant species are likely to have absorbed some of the hazardous substances.

Green algae and "periphyton" occur in most of the aqueous environments within ORR watersheds (Upper East Fork Poplar Creek). Periphyton is a term used to describe communities of microorganisms that are attached to various aquatic substrates and grow as thick gelatinous mats of mixed assemblages including green algae, cyanobacteria, fungi, associated macrophytes (e.g., cattails, duckweed, water spangles, etc.), invertebrate grazers (e.g., snails), and detritus. Periphyton biomass produces much of the low-end of the food chain for many aquatic organisms and herbivores and are sensitive indicators of environmental physiochemical change and bioaccumulation of hazardous substances.

Prospective habitats both on and off-site of the ORR such as springs, seeps, karst features, streams, wetlands, impoundments (ponds), landfills, creek embankments, rock outcrops, state Natural Areas, and other terrestrial ecosystems will receive priority as potential sampling and monitoring sites (see Figures 1 and 2). Watersheds such as Bear Creek and its tributaries, White Oak Creek/Lake and its tributaries, and Mitchell Branch are all probable target habitats for sampling.

Figure 1: Potential Aquatic Plant Sampling Locations - East Half of ORR

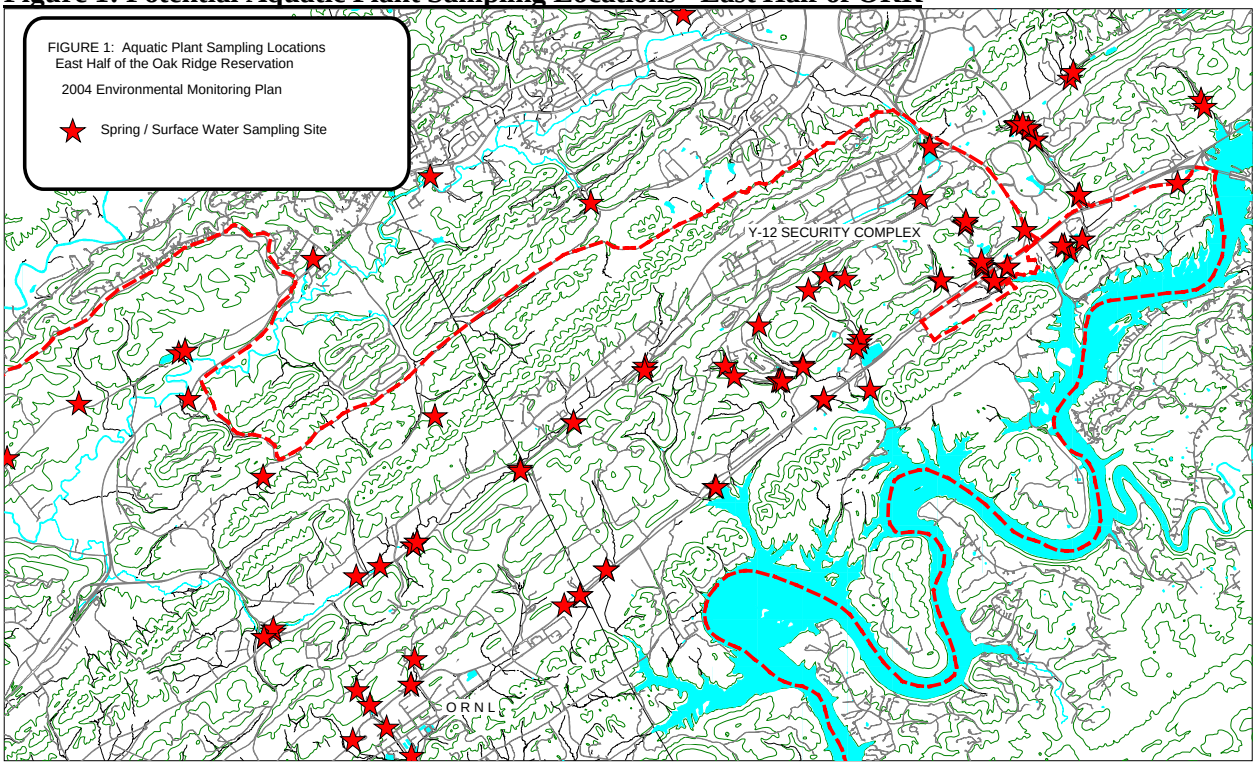
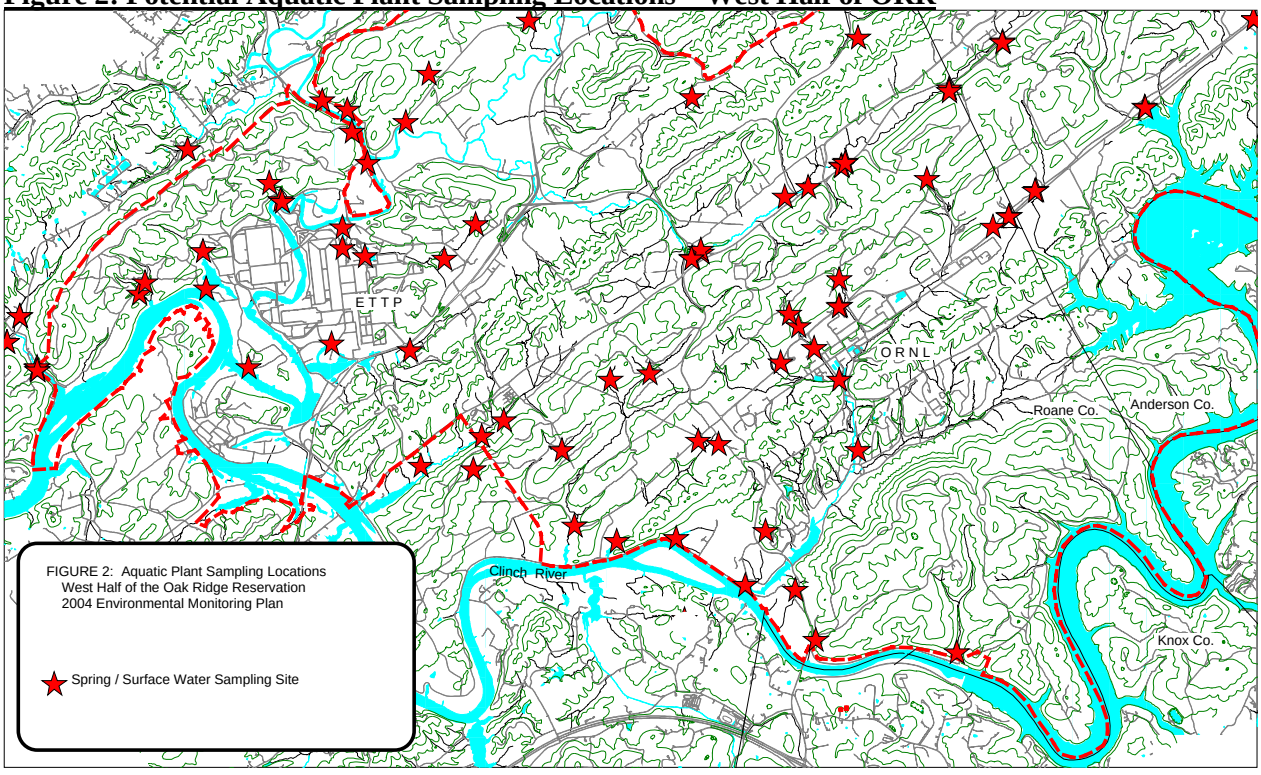


Figure 2: Potential Aquatic Plant Sampling Locations – West Half of ORR



The first two sampling seasons (2002-03) involved the sampling and analysis of watercress, algae, and aquatic vegetation. For 2004 the project broadens in scope to include determinations of the

ecological implications of these findings. Additionally, and new for 2004, the sampling of green algae (i.e., diatoms) will include taxonomy and systematics to classify these plants down at least to the family level and perhaps to the genus level. The purpose is to assist ORNL staff involved with the periphyton sampling and monitoring (BMAP project) of Upper East Fork Poplar Creek.

Methods and Materials

Field samples will be collected at predetermined habitats and ecosystems both on the ORR and offsite (for background data). Plastic ziplock baggies and plastic (jar-like) containers will be used for collection of samples in the field. Rubber/plastic gloves will be worn during sampling activities. Each sampling location will be assigned an identification number (established spring names will be used for watercress samples) and mapped using global positioning system (GPS) technology. Rock substrate or Plexiglas plates will be used to sample the periphyton (diatoms).

Arrangements will be made in advance with appropriate Tennessee Oversight Agreement site coordinators for ingress/egress to radiological areas, to obtain Radiation Worker Permits, if necessary and for the presence of health physics technicians on an as-needed basis. All samples will be screened radiologically in the field prior to returning to the division's office. Using radiological counting equipment available in the division laboratory, exposure rates (dose) will be calculated from selected field samples to determine exposure, absorbed dose, etc. Periphyton (diatoms) will be identified using available TDEC microscopes and lab manuals (ORNL lab space & microscope equipment is available for taxonomy purposes upon request).

Samples collected will be shipped to the state Environmental Laboratory in Nashville for analysis of metals, gross alpha-beta and gross gamma parameters. The sampling and analysis plan will remain flexible as some samples may be analyzed in the division laboratory. Sampling and monitoring for the project will focus on:

(1) Plant species in off-site habitats known to be uncontaminated (baseline data)
(2) Plant species in ORR habitats where there is known radiological contamination

Target radionuclides being somewhat mobile and occurring in the ORR environment as contamination include (but are not limited to):

(1) Cesium-137
(2) Strontium-90
(3) Cobalt-60
(4) Uranium isotopes and daughter products
(5) Technetium-99

Sampling protocol and quality control methods will follow the guidelines in the division's "Standard Operating Procedures" and the "Health, Safety, and Security Plan." Field techniques and laboratory methods will follow standard ASTM, EPA, and FRMAC methodology, sampling, and operating procedures. Standard Operating Procedures for the project include (but not limited to):

(1) ASTM Guidelines:

ASTM Volume 11.02 – Organic Constituents/Radioactivity/Microbiological
ASTM Volume 11.05 – Biological Effects & Environmental Fate/Biotechnology
ASTM Volume 12.02 – Nuclear/Solar/Geothermal/Dosimetry/Radiation Effects

(2) Federal Manual for Sample Processing and Analysis Manual (FRMAC) – 1996:

Vol. 1 – Radiation Monitoring & Sampling - Field Sampling: Vegetation/Fruit Sampling, Supplies and Procedure

Vol. 2 - Sample Preparation and Analysis – Method 6: Preparation of FRMAC Field Samples

Vol. 2 - Sample Preparation and Analysis – Method 7: Gamma Emitting Radionuclides in FRMAC Samples

(3) U.S.G.S. Methods for Collection and Analysis of Aquatic Biological & Microbiological Samples: Book 5, Chapter A4

(4) U. S. Army Corps of Engineers: Wetlands Delineation Manual

(5) U. S. EPA Standard Operating Procedure – Ash Free Dry Basis – Periphyton

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CHAPTER 3 DRINKING WATE R

Sampling of Oak Ridge Reservation Potable Water Distribution Systems

Introduction

The water distribution systems at each of the DOE ORR sites are regulated by the *Tennessee Safe Drinking Water Act* (T. C. A. 68-13-701) and the *Regulations for Public Water Systems and Drinking Water Quality* (Chapter 1200-5-1). The Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division) may conduct oversight of sampling for total coliform bacteria and free chlorine residuals at various sites throughout the potable water distribution systems on the Oak Ridge Reservation (ORR). In addition, the division may oversee ORR line-flushing practices, water main repairs, cross-connection control programs, and water-loss/leak detection activities in order to identify potential threats to the potable water supply. If potential threats are identified, then additional chemical and radiological sampling may be conducted to insure that the quality of the potable water is maintained.

The division, through a memorandum of understanding (MOU) with the TDEC Division of Water Supply (DWS), reviews chemical and bacteriological sampling results from the water systems on the ORR. Review of these sampling results combined with knowledge of localized plant populations and water demand, backflow device location, testing and maintenance procedures, line repairs or maintenance, and proximity of water lines identified on site maps to radiological or non-radiological source waters will provide a basis for TDEC independent sampling when evidence exists of possible shallow subsurface plume infiltration, cross connections, low chlorine residuals, or other upset conditions. Confirmation of any detects reported can dictate additional sampling or split samples. Continued detects may justify increased monitoring for that compound.

Methods and Materials

The following sections provide information regarding the sample processing and analytical laboratory procedures.

Free Chlorine Residual

The sample will be collected into two of the small sample containers provided with the Hach Pocket Colorimeter Kit. One of the samples will be designated as the blank sample and the other will be the actual sample to be analyzed. A DPD powder pillow is poured into the sample container and gently shaken and allowed to sit for three minutes. After three minutes, the blank is placed into the pocket colorimeter and the “zero” button is depressed. The blank container is removed and replaced with the sample container. The “read” button is depressed and the free chlorine residual is read directly from the pocket colorimeter display.

Bacteriological

The U.S. Environmental Protection Agency (EPA) approved method for coliforms, Colilert in the pass/fail mode, will be the methodology utilized by the Tennessee Department of Health, Environmental Laboratory and Microbiology Laboratory Organization (Laboratory Services). For bacteriological testing on raw water sources, the counting application of the Colilert kits would be identified and utilized. The Lab has expertise in a broad scope of services and analysis available to the division and other TDEC divisions statewide.

Organic, Inorganic and Radiological

Analytical methods are provided in the Standard Operating Procedures (SOP) manuals for the Tennessee Laboratory Services Division. The SOPs refers to proper EPA or other methods. In order to assess methods used division staff should communicate with their sampling and analytical counterparts within the ORR on a basis that facilitates technical exchange and openness. General sampling and analysis methods are to follow EPA guidelines as listed in appropriate parts of 40 Code of Federal Regulations (CFR).

Quality Control/Quality Assurance

If independent sampling activities are conducted, care will be taken to include quality control samples. The level of quality control methodology implemented will be commensurate with the level of independent sampling. Forms of control sampling to be considered will be blanks, duplicate analysis, division split samples, or even split samples with site DOE contractor. Information pertaining to the quality control samples will be included in program files, spreadsheets, and a bound notebook similar to actual samples.

Equipment that will be required to accomplish this oversight and sampling project:

- Latex/vinyl gloves
- Hach Pocket Colorimeter Kit
- Hach free chlorine DPD powder pillows
- Bound field book
- State vehicle
- Health, Safety, and Security Plan
- Sample bottles
- Sampling cooler
- Disinfectant (full strength) spray bottle

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CHAPTER 3 DRINKING WATE R

Implementation of EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Drinking Water Program

Introduction

Radiological contaminants released on the Oak Ridge Reservation (ORR) enter local streams and are transported to the Clinch River. While monitoring of the river and local water treatment facilities has indicated concentrations of radioactive contaminants are below regulatory criteria, there has remained a concern that area public water supplies could be impacted by ORR pollutants. In response to these concerns, the Tennessee Department of Environment and Conservation Division of DOE Oversight (the division) began participation in EPA's Environmental Radiation Ambient Monitoring System (ERAMS) in 1996. This program provides for radiological monitoring of public water supplies near nuclear facilities throughout the United States. In this regard, the ERAMS program is designed to:

1. Monitor pathways for significant population exposure from routine and/or accidental releases of radioactivity;
2. Provide data indicating additional sampling needs or other actions required to ensure public health and environmental quality;
3. Serve as a reference for data comparison (U.S. EPA, 1988)

The ERAMS program also provides a mechanism to evaluate the impact of DOE activities on water systems located in the vicinity of the Oak Ridge Reservation and verify DOE monitoring in accord with the *Tennessee Oversight Agreement* (TDEC, 2001).

Methods and Materials

As in the past, EPA will provide radiochemical analysis of finished drinking water samples collected quarterly by division staff at five public water supplies located on and in the vicinity of the ORR. This analysis will be performed at EPA's National Air and Radiation Environmental Laboratory in Montgomery, Alabama. ERAMS analytical frequencies and parameters are provided in Table 1.

Table 1: Environmental Radiation Ambient Monitoring System Analysis for Drinking Water

ANALYSIS	FREQUENCY
Tritium	Quarterly
Gross Alpha	Annually on composite samples
Gross Beta	Annually on composite samples
Gamma Scan	Annually on composite samples
Iodine-131	Annually on one individual sample/sampling site
Radium-226	Annually on samples with gross alpha >2 pCi/L
Radium-228	On samples with Radium-226 between 3-5 pCi/L
Strontium-90	Annually on composite samples
Plutonium-238, Plutonium-239, Plutonium-240	Annually on samples with gross alpha >2 pCi/L
Uranium-234, Uranium-235, Uranium-238	Annually on samples with gross alpha >2 pCi/L

The five Oak Ridge area monitoring locations are: Kingston Water Treatment Plant, Gallaher (K-25) Water Treatment Plant, West Knox Utility, city of Oak Ridge Water Treatment Facility

(formerly DOE Water Treatment Plant at Y-12), and Anderson County Utility District. Figure 1 depicts the approximate locations of raw water intakes associated with these facilities.

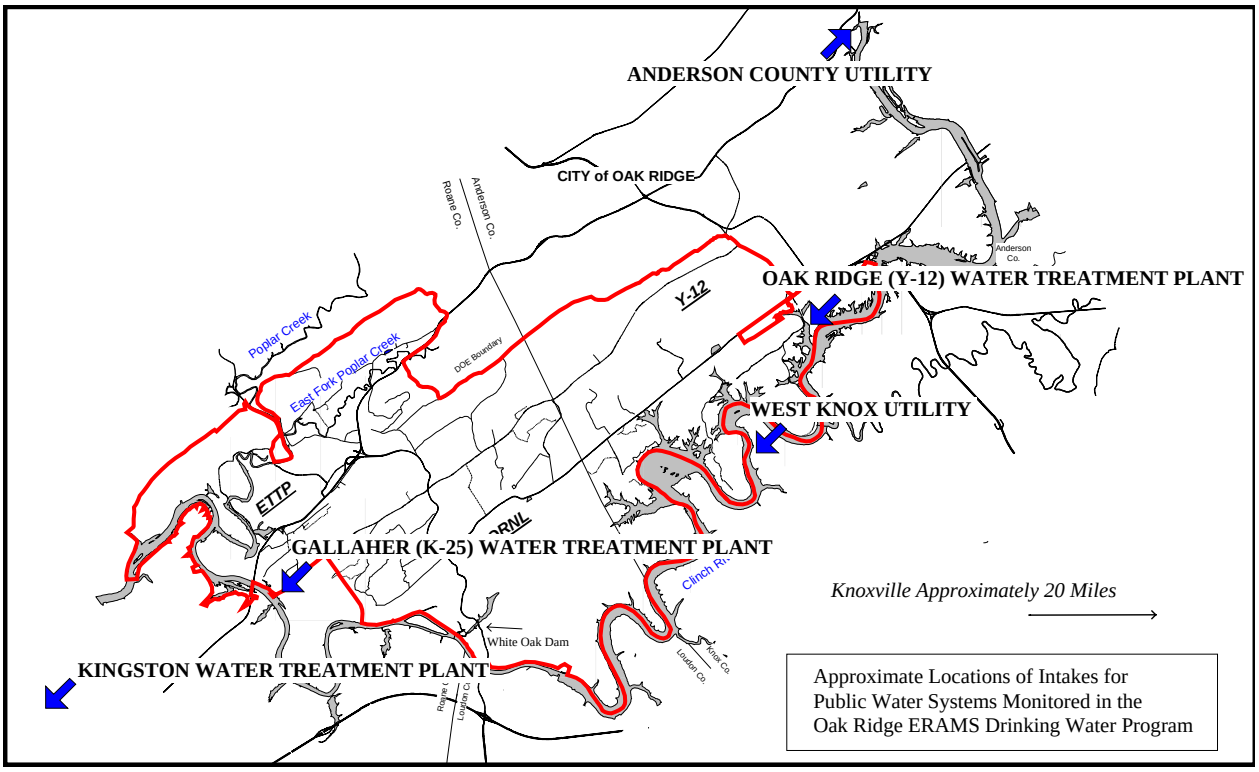

Figure 1: Approximate Locations of the Intakes for Public Water Systems Monitored in Association with EPA's Environmental Radiation Ambient Monitoring System (ERAMS) Drinking Water Program

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CHAPTER 3 DRINKING WATE R

Radiological Analysis of Drinking Water at Oak Ridge National Laboratory

Introduction

The Tennessee Department of Environment and Conservation, Department of Energy Oversight Division (the division) will conduct sampling of drinking water at Oak Ridge National Laboratory (ORNL) for radiological contaminants. This sampling is to address the possible infiltration of radiological contaminants into the drinking water distribution system in the vicinity of the High Flux Isotope Reactor (HFIR). This area has been identified as having subsurface radiological contamination. In addition, the sampling will aid in the identification of infiltration that may be occurring.

This plan will also serve as a template for additional sampling at ORNL, or the other DOE facilities, in the event of a large pressure drop of the distribution system due to major failure or significant water loss from firefighting or flushing.

Methods and Materials

Analysis of distribution maps and schematics will be utilized to identify five locations in the area of HFIR. This method will also be used for other samplings conducted when there is an identified need. In addition, a reference sample will be collected at the Oak Ridge Water Treatment Plant.

The following parameters will be analyzed for:

Site	Analysis
HFIR	Gross Alpha/Beta
	Gamma Spec
	Tritium

When other locations are being sampled, the parameters analyzed for will vary depending upon the contaminants of concern in the area of the distribution system failure. The parameters analyzed will be chosen from process knowledge and other gathered data, e.g. plume maps, Remedial Investigations etc.

As prescribed by the *Tennessee Regulations for Public Water Systems and Drinking Water Quality - Chapter 1200-5-1-.11,* radiochemical analysis shall be in accordance with the latest methods published by the U.S. EPA.

When necessary, organic and inorganic sampling and analysis methodologies are specifically prescribed in the *Tennessee Regulations for Public Water Systems and Drinking Water Quality - Chapter 1200-5-1-.09 & - .10*. Adherence to these specifications will be maintained as sampling within this program is conducted.

Information regarding the samples, as they are collected, will be entered into a bound field book. A unique name will be chosen for any samples taken utilizing the single letter designation for the DOE plant sites (X,Y,K), the building number, as well as an increasing numerical counter (1,2,3, etc) which determines the chronological order of any samples. The specific tap information pertaining to such samples will be clearly identified within the bound field book.

Materials:

- Latex or vinyl gloves
- Bound field book
- State vehicle
- Health, Safety, and Security Plan
- Sample bottles
- Sampling cooler

Analytical methods are provided in the Standard Operating Procedures (SOP) manuals for the Tennessee Laboratory Services Division. The SOPs refer to proper EPA or other methods. In order to assess methods used division staff should communicate with their sampling and analytical counterparts within the ORR on a basis that facilitates technical exchange and openness. General sampling and analysis methods are to follow EPA guidelines as listed in appropriate parts of 40 Code of Federal Regulations (CFR).

References

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CHAPTER 4 GROUNDWATER MONITORING

Surveillance Monitoring of Groundwater Solvent Plumes Crossing the Oak Ridge Reservation Boundary

Introduction

The primary goals of the DOE-Oversight Division's groundwater section sampling program are:

- Perform surveillance to detect changes in groundwater quality at select locations;
- Locate groundwater exit pathways and;
- Locate groundwater impacts from past DOE Oak Ridge Reservation (ORR) operations both on-site and off-site

The Groundwater Section by means of monitoring groundwater discharges at springs along both sides of the reservation boundary will investigate spatial distributions of current solvent plumes. Two target areas beginning in the calendar year 2004 will be monitored: Upper East Fork Poplar Creek /Chestnut Ridge Hydrologic Regimes near Y-12 and the East Tennessee Technology Park (ETTP) boundary along Poplar Creek (See Maps 1&2). These DOE contaminated groundwater plumes that have spread to off-site public accessible locations are from mostly solvent release locations. Changes in the concentration or distribution in these plumes appear to be occurring. It is the goal of this plan to get a current assessment of the plume changes to assist and advise DOE in a way to assure DOE activities do not adversely impact public health.

The spring months of 2004 (the wet season) will see the most fieldwork and sampling. Analysis and data review is expected to occur in the summer months. A second round of fieldwork is anticipated in the fall (dry season). Tracing groundwater will likely start near the end of the dry season.

Methods and Materials

Based on availability of equipment the following hydrogeology techniques will be used:
Sampling springs, surface flows, and wells for Volatile Organic Compounds (VOCs). Samples will be taken in accordance to standard operating procedures. Field estimates and measurements of flows will be made using flow meters and cross-sectional determinations. Possible introduction of tracing dyes to wells and sinking water connected to the underlying aquifer may be utilized for identifications of flow paths and travel times. When a likely source of contamination is found and springs or wells indicate a similar signature of contaminants then a trace will be initiated with background sampling for dye. Traces starting with wells will require support and resources from DOE. Individual traces will be documented with dye amounts, placement locations, and monitoring locations in a separate addendum. These addenda will contain the following:

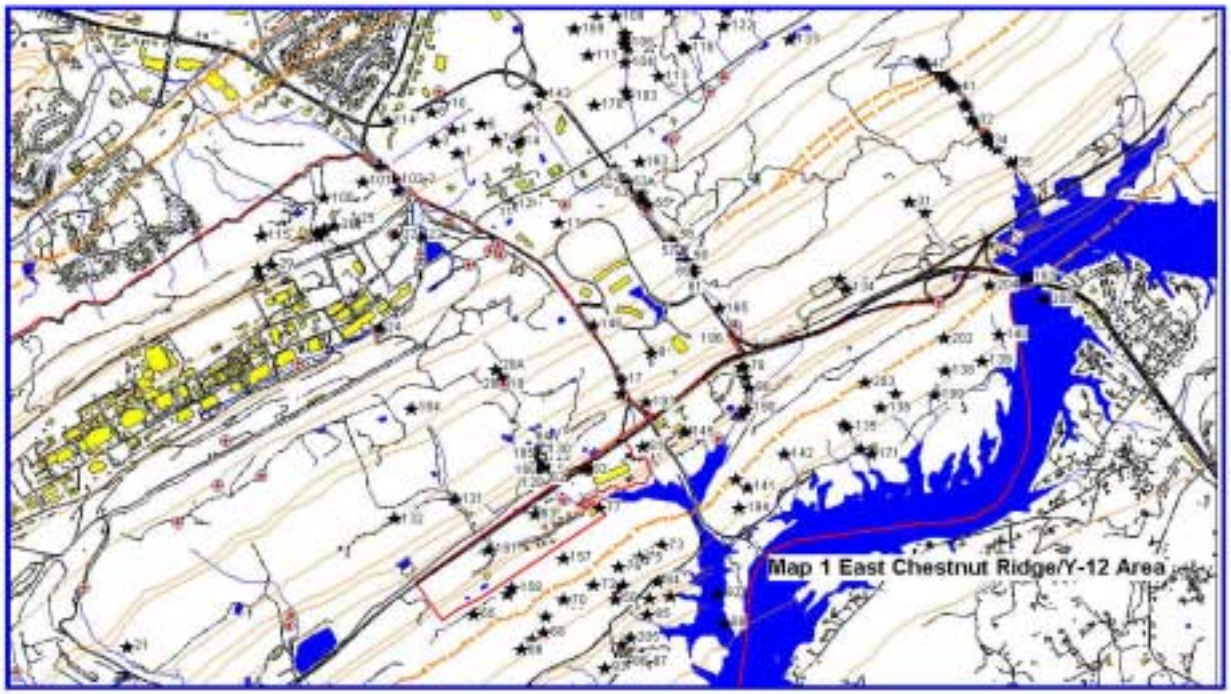
- Type of dye to be flushed
- Amount of dye to be flushed
- Location of dye placement point(s)
- Location of monitoring points on maps showing location in relation to active or inactive DOE facilities

The use of field parameters such as specific conductivity and temperature will be used to discriminate multiple discharges. Wells, if sampled, will be done in coordination with the DOE and contractors that have appropriate equipment to sample a well.

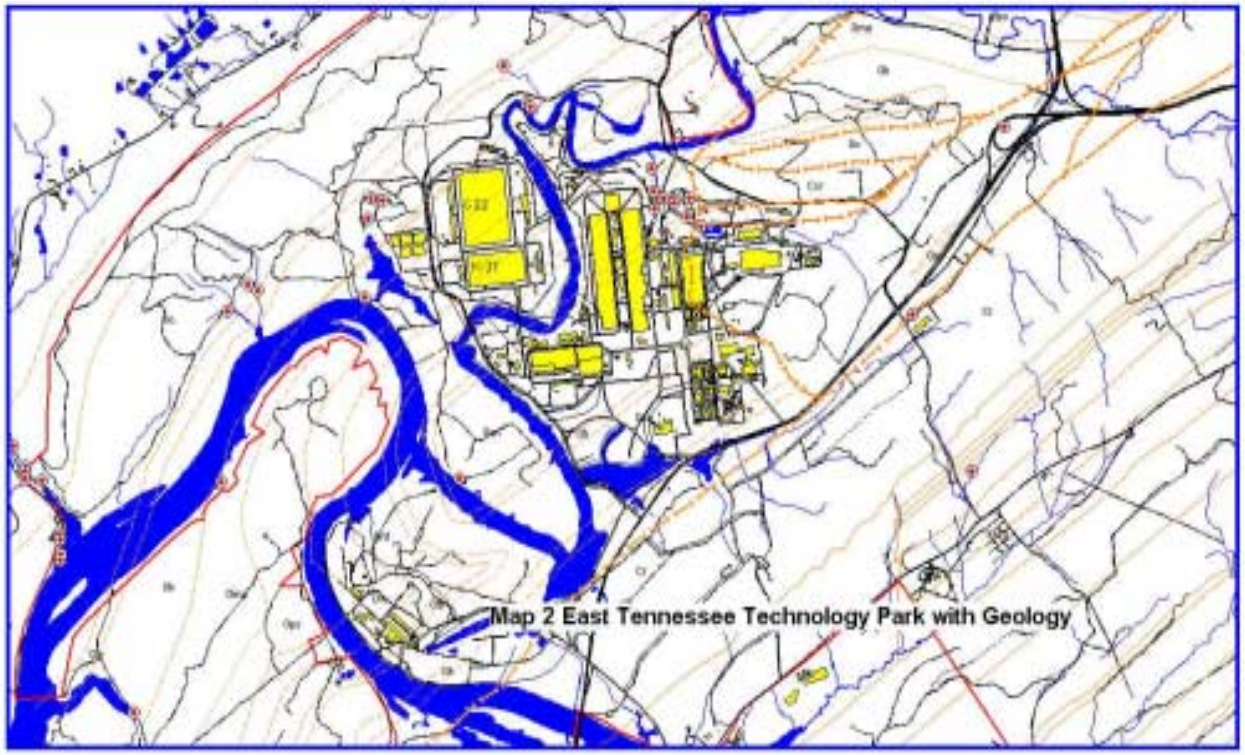
The TDEC analytical laboratory in Knoxville, Tennessee will furnish sample containers and preservatives. Disposable gloves and personal protective equipment will be used in collecting samples. Samples will be transported to the DOE-Oversight office before submitting to the Knoxville Basin Laboratory. Data loggers similar to ones used by other state agencies, if acquired, will be used to define aquifer/contaminant behavior.

DOE Coordination/Communication

Notice during the week prior to sampling will be given to DOE to allow DOE the opportunity to observe or take split samples. Analytical results will be made available upon request. All final results and findings will be reported in the DOE-Oversight's Environmental Monitoring Report.
Addenda will be distributed to those individuals at the facilities (Resource Management Organization, Laboratory or Plant Shift Superintendent) and DOE contacts, UT-Battelle/Bechtel Jacobs/BWXT contacts and the division managers.



Map 1 East Chestnut Ridge/Y-12 Area with Geology and identified springs.



Map 2 East Technology Park with Geology

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CHAPTER 4 GROUNDWATER MONITORING

Off-Site Residential Well Sampling Work Plan

Project Description

The goal of this project is to identify potential exit pathways for contamination from the Oak Ridge Reservation (ORR) and to monitor for contamination. The Tennessee Department of Environment and Conservation DOE Oversight Division (the division) is planning to collect water samples for analysis only from new residential wells in the areas off-site from the ORR and those well users requesting sampling. Wells sampled are based upon the potential for groundwater impact from past ORR operations. Analysis information will be provided to the well owners along with assistance, if needed.

Introduction

The primary goal of the Tennessee Department of Environment and Conservation DOE Oversight Division's (the division) residential well sampling program is to determine the impact from past ORR operations on groundwater off-site from the ORR

Six years of division monitoring has not currently identified wells affected by DOE activities. Therefore the division will discontinue routine sampling of residential wells. Sampling of residential wells will only be conducted on a written request basis or from newly drilled wells (since 1999) that would provide advantageous locations to monitor for effects from DOE activities. Continued communication to the public offering the opportunity for well water analysis will be maintained through public meetings, the Local Oversight Committee, and the Site Specific Advisory Board.

This project will be accomplished by identifying potential exit pathways for contamination from the Oak Ridge Reservation (ORR) and to monitor for that contamination. Areas along geologic strike from Y-12, X-10, and the K-25 facility contain wells most likely to be sampled. The current program is focusing on wells not available during earlier surveys and well-user requests. Analytical parameters will include radionuclides and selected metals, inorganic analytes and volatile organics. Parameters will vary depending on the potential for off-site groundwater contamination within a given area. See Table 1 for a list of analytes to be completed for each sampling point.

Methods and Materials

Criteria for Residential Well Sampling:

- Residential wells meeting the criteria of being within or very near a one-mile radius of the 2003 Oak Ridge Reservation boundary may be sampled for radiochemistry parameters.

- Where indicated by results from a certified lab, additional parameters maybe taken like cation-ion species, bacteriological and organic compounds to help understand the quality of the well construction and conditions in the water quality.

- Owners of new wells (wells drilled since 1999) within the boundary found out by driller records or field observations will be approached by mail, phone or visit to obtain permission

to test their well for this program (Figure 1). Well owners with a written request may have their well tested provided there are hydrogeologic reasons. These reasons include along strike locations, contaminant migration pathways, or within the one-mile radius.

- Information on well construction should be obtained from the owner, the driller and state of Tennessee records when available.

- The goal of this program is to respond to concerns of private water source owners in a timely fashion so that current or past releases from DOE can be identified.

Sampling Method

Wells will be sampled by collecting samples as close to the well head as possible. The wells will be purged by letting the water run for at least 20 minutes. This should allow the parameters in the well to stabilize and minimize any effects from any holding tank. 'Garden' hoses will be used to direct the water away from homes or well houses and will be disconnected before sampling occurs. Parameters; such as, pH, temperature, and conductivity will be collected before, during, and immediately after sampling and recorded on a sampling sheet completed during sampling.

Analyte lists will be determined prior to sampling. Wells deemed to potentially be influenced by K-25 would include Tc-99 in radiological sampling and not Sr-90. Those wells that may be influenced by X-10 will include Sr-90 in the radiological sampling and drop Tc-99. Upon receipt of the analysis, if the gross alpha activity is greater than 5 pCi/L then a radionuclide specific analysis for alpha emitters will be performed on an archived sample or another sample will be collected.

The TDEC analytical laboratory in Knoxville, Tennessee will furnish sample containers. Samples will be collected using approved TDEC and EPA sampling procedures. Vinyl exam gloves and decontamination equipment and procedures will be necessary to avoid cross contamination. The division's sample coolers will be used to insure that samples are preserved in route to the laboratory.

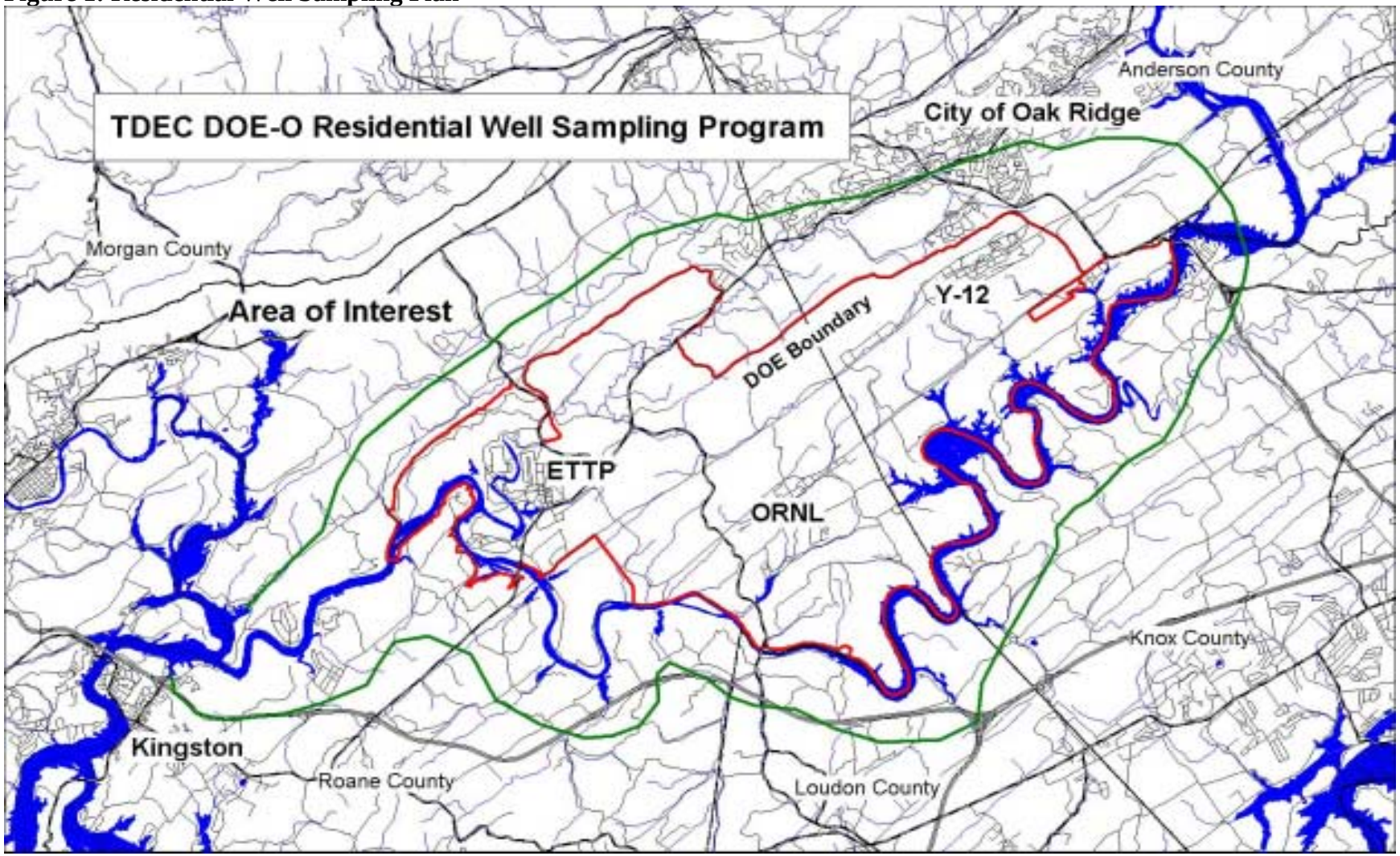
DOE Coordination/Communication

Upon selection of sampling points DOE will be notified by contacting the DOE Environmental Management Ground Water Program Manager by e-mail and by letter. Ample notice will be given to DOE prior to sampling events in order to give DOE the opportunity to observe or take split samples. Analytical results will be made available upon request.

TABLE 1
RESIDENTIAL WELL ANALYTE LIST

Analyte Group	Analyte
VOCs	**TCL List**
Radiochemical	**Gross Alpha**/Beta**
	Tc-99
	Tritium
	Gamma Spec
	Sr-90
Metals	
	Uranium (Metal)
	Lead
	Thallium
	Mercury
Inorganics	TSS
	TDS
Initial sampling only, continued analysis to be determined	
**If Gross alpha is >5 pCi/L radionuclide specific analyses will be performed at extra cost	
Bold analytes for continued sampling	

Figure 1: Residential Well Sampling Plan



Appendices

None

References

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CHAPTER 5 RADIOLOGICAL MONITORING

Ambient Gamma Radiation Monitoring of the Uranium Hexafluoride (UF6) Cylinder Yards at the K-25 (East Tennessee Technology Park) Site

Introduction

During the development and operation of the gaseous diffusion uranium enrichment process, containers, support equipment, and support facilities were designed, constructed, and used to store, transport, and process the depleted UF_6. After a significant inventory was produced, outdoor storage facilities "cylinder yards" evolved. Today, DOE operates the six K-25 (East Tennessee Technology Park) UF_6 cylinder storage yards. They are used for the temporary and long-term storage of UF_6 cylinders. The goal of the DOE-O UF_6 Cylinder Yard dose assessment program is to evaluate if the public is protected from radiation doses emitted from the cylinder yards. This is especially important since one DOE mission is to transform the East Tennessee Technology Park into a commercial industrial park.

Methods and Materials

Dosimeters measure the dose from exposure to gamma radiation over time. The division's cylinder yard monitoring is performed using Luxel® OSL (optically stimulated luminescence) dosimeters. They are obtained from Landauer, Inc., in Glenwood, Illinois. Optically stimulated luminescence dosimeters have an exposure range from 1 mrem to 1,000 rem for X and gamma radiation and are generally placed in areas where exposures are expected to be significantly higher than background. The dosimeters are collected quarterly by division staff and shipped to Landauer for processing. To account for exposures that may be received in transit or storage, control dosimeters are included in each shipment from the Landauer Company. The control dosimeters are stored at the division office and returned to Landauer with the associated 'in the field' deployed dosimeters for processing. Any exposure received by the control dosimeters, which would include background radiation received while in storage at the division office (761 Emory Valley Road, Oak Ridge, Tennessee), is subtracted from the exposure reported for the field deployed dosimeters. Annually, the quarterly exposures (minus the exposure obtained from the control dosimeter) are summed for each location. The resultant annual dose is compared to the state/DOE primary dose limit for members of the public (100-mrem/yr exposure). In addition to radiation dose measurements being gathered, dosimeter location data has been obtained using Global Positioning System (GPS) equipment. This data has been incorporated into a mapping information computer program. The location data that has been entered into the MapInfo program will be incorporated with past radiation dose measurement data so the user will have the ability to select a particular dosimeter and view its historical dose exposure measurement.

References

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MapInfo Corporation. *MapInfo Professional Version 4.0.2.* Troy, New York. 1996.

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CHAPTER 5 RADIOLOGICAL MONITORING

Facility Survey Program and Infrastructure Reduction Activity

Introduction

The Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division), in cooperation with the U.S. Department of Energy and its contractors, operates a facility survey program on the Oak Ridge Reservation (ORR). The division's survey program provides a comprehensive independent characterization of facilities on the ORR based on their: operational history, present mission and physical condition, inventories of radiological and/or hazardous materials, degree of contamination, contaminant release history and potential for release of contaminants to the environment.

The goal of the program is to fulfill part of the commitments agreed to by the state of Tennessee and the Department of Energy in Section 1.2.3 of the *Tennessee Oversight Agreement*, which states that *"Tennessee will pursue the initiatives in attachments A, C, E, F, and G. The general intent of these action items is to continue Tennessee's: (1) environmental monitoring, oversight and environmental restoration programs; (2) emergency preparedness programs; and (3) delivery of a better understanding to the local governments and the public of past and present operations on the ORR and potential impacts on the human health and/or environment by the Oak Ridge Reservation."* As part of this larger endeavor, *the facility survey program is designed to provide a detailed assessment of all potential hazards affecting or in any way associated with facilities on the Oak Ridge Reservation.* To meet this objective, survey team members walk through each facility and gather information that is recorded in a database that allows the team to characterize facilities and evaluate their potential for release of contaminants to the environment. The conditions of facilities are considered within a variety of environmental conditions ranging from catastrophic (i.e. tornado, earthquake) to normal everyday working situations. From an emergency preparedness perspective such information is essential.

In 2002, the Department of Energy instituted a formal, accelerated D&D program aimed at facility reduction through demolition. Facility survey staff responded to this activity by making facility visits and walk-throughs of each facility prior to, and during demolition. Information concerning the nature and destination of waste streams from the demolition sites is gathered and submitted to the division's Waste Management section. This activity will continue in 2004.

Methods and Materials

The criteria used in the selection of facilities to be surveyed include: 1) position of facility in S&M/D&D programs; 2) perceived physical condition of facility; 3) perceived levels of contamination; 4) types or quantities of inventories (hazardous or radiological); and 5) special circumstances (incidents, public or other agency request, or other unforeseen situations).

Using standard radiation survey instruments, inventory data, and historical documentation, staff walk through each facility and record information in a questionaire format. Based on these results and professional judgement, staff then rank the potential for release of contaminants to the environment for each facility by scoring 0 (least potential) to 5 (greatest potential) for each of 10 "categories." Tables 1 and 2 illustrate the scoring guidelines for potential environmental release, and the categories to be scored.

Table 1: Potential for Environmental Release Scoring Guidelines

Score	Score is based on observations in the field and the historic and present-day threat of contaminant release to the environment/building and/or ecological receptors.
0	No potential: no quantities of radiological or hazardous substances present.
1	Low potential: minimal quantities present, possibility of an insignificant release, very small probability of significant release, modern maintained containment.
2	Medium potential: radiological or hazardous subs. present, structures stable in the near to long term, structures have integrity but are not state-of-the-art, adequate maintenance.
3	Medium potential: structures unstable, in disrepair, containment failure clearly dependent on time, integrity bad, maintenance lacking, containment exists for the short term only.
4	High potential: radiological or hazardous subs. present. Containment for any period of time is questionable, migration to environment has not started.
5	Radiological or hazardous substance containment definitely breached, environmental/interior pollution from structures detected, radiological and/or hazardous substances in inappropriate places like sumps/drains/floors, release in progress, or radiological exposure rates above Nuclear Regulatory Commission (NRC) guidance.
Note: A score of 0 or 1 designates a low Potential Environmental Release rank; a score of 2 or 3 designates a moderate rank; a score of 4 or 5 designates a high rank.	

Table 2: Ten Categories Scored

1.	Sanitary lines, drains, septic systems
2.	Process tanks, lines, and pumps
3.	Liquid Low-level Waste tanks, lines, sumps, and pumps
4.	Floor drains and sumps
5.	Transferable radiological contamination
6.	Transferable hazardous materials contamination or waste
7.	Ventilation ducts and exit pathways to create outdoor air pollution
8.	Ventilation ducts and indoor air/building contamination threat
9.	Escalated radiation exposure rates inside the facility
10.	Escalated radiation exposure rates outside the facility

As facilities are surveyed, scored, and compared with each other, a relative "*potential for environmental release*" will emerge. The facilities that show a high potential for release of contaminants will be noted in the program's annual report. Staff will revisit these facilities at their discretion to evaluate changing conditions. Table 3 provides a list of target facilities to be surveyed during the next year.

Table 3: Target Schedule of Facilities to be Surveyed *

ORNL		Y-12		K-25	
Facility	Date	Facility	Date	Facility	Date
X-3550	**Feb. 1**	**Y-9610**	**Nov. 15**	**On demand**	
		Y-9720-16	**Jan. 1**		
		Y-9983-73	**Mar. 1**		
		Y-9720-53	**Mar. 1**		
		Y-1501-2	**April 15**		
		Y-9404-9	**June 1**		
		Y-9720-19	**July 15**		
		Y-9720-19A	**Sept. 1**		
		Y-9720-19B	**Sept. 1**		
		Y-9401-1	**Nov. 1**		

***Facility numbers and dates are subject to change.**

Appendices

None

References

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CHAPTER 5 RADIOLOGICAL MONITORING

Walkover Radiological Surveys

Introduction

The Tennessee Department of Environment and Conservation DOE Oversight Division (the division) with the cooperation of the Department of Energy and its contractors conduct periodical radiological walkover surveys for the purpose of evaluating DOE property for re-use. Walkover surveys are done in conjunction with the CERCLA 120(h) process of establishing clean areas while following direct guidelines.

Background History of the Project

The Footprint Reduction Project focused on land parcels of the Reservation considered not to be impacted by former DOE activities. This current project will focus on those areas suspected of being impacted that will require minimal or no remediation, once a valid investigation and survey is concluded. Table 1 lists those areas of concern generated during the Footprint Reduction Project that will be revisited. Table 2 lists those areas of low priority under Appendix C of the Federal Facility Agreement.

Methods and Materials

The Walkover Surveys are conducted using a physical approach. Background material of the area is evaluated prior to a drive through of the area. From there, a walkover of the area is conducted with the use of a sodium iodide (gamma detector). Other radiological instruments are on hand as necessary. These include a beta-gamma pancake, a zinc scintillator for alpha, a micro-rem for tissue dose equivalence and a gamma spectroscopy for isotope identification. Areas with staining of soil or stressed vegetation are noted for sampling.

Staff conducts a thorough walkover of the area with the use of a global positioning system (GPS). Areas of concern, as well as other points, are logged to show coverage. A map of the area is printed out with points of interest or concerns plotted. A report is generated with the state's findings. Concerns are brought to the attention of the Federal Facility Agreement Project Managers for resolution.

Table 1
List of Maintenance Action Sites Identified by TDEC Field Surveys
Footprint Reduction Process

Parcel 1: West Black Oak Ridge Study Area

- TDEC field station 101: Abandoned 55-gallon steel drum (empty)
- TDEC field station 127: Old dumpsite (tires, roofing, scrap metal, etc)
- TDEC field station 129: Small shed with above background levels of fixed gamma contamination
- TDEC field station 134: Large abandoned hollow fill

Table 1 Continued

Parcel 2: East Black Oak Ridge Study Area

- None specified

Parcel 3: McKinney Ridge Study Area

- None specified

Parcel 4a: East Fork Ridge/White Wing Study Area

- TDEC field stations 24 & 125: Abandoned 55-gallon drums
- TDEC field stations 105-125: Numerous abandoned hydrologic experimental equipment
- TDEC field station 157: Remains of plywood shack and drums

Parcel 4b: Pine Ridge Study Area

- TDEC field station 89: Abandoned barrel with residual fuel oil

Parcels 5/6: West Pine Ridge Study Area

- TDEC field station 44: Old Dump Site at west end of Happy Valley Campsite
- Radiological surveys should be conducted prior to use of federal land adjacent to the Consolidated Clinch River Industrial Park to ensure potential exposure is minimized

Parcels 7/18: West Chestnut Ridge/West Bethel Valley Study Area

- TDEC field station 14: Abandoned 55-gallon drum
- TDEC field station 26: Pile of scrap metal
- TDEC field station 35: Abandoned automatic sampling equipment along small creek
- TDEC field station 49: Experimental hydrologic site with abandoned apparatus & gear (messy)
- TDEC field station 89: Abandoned hyrdologic/precipitation experimental equipment
- TDEC field station 103: Abandoned soil percolation test trenches & gear
- TDEC field station 105: Abandoned hydrologic experimental equipment strewn about the hillside
- TDEC field station 114: Abandoned experimental site & gear
- TDEC field station 193: Abandoned percolation test trench & gear
- TDEC field stations 250/251: Abandoned hydrologic test site with a tremendous amount of gear/trash

Parcel 8: Central Chestnut Ridge Study Area

- TDEC field station 15 vicinity: Debris & scrap metal strewn about the NOAA/ATDD facility
- TDEC field station 168: Possible SWMU site identified by ORNL personnel; dumped asphalt, concrete & fairly recent garbage disposal

Table 1 Continued

Parcel 9: Walker Branch Study Area

- Removal action is recommended for abandoned experimental gear, scrap metal, hydrologic test equipment, & trash strewn about the parcel
- TDEC field station 77: Removal action for miscellaneous trash & debris associated with the new SWMU 0.81 site located between Old & New Bethel Valley Road

Parcel 11: Copper Ridge Study Area

- TDEC field station 27: General vicinity of the Civil Defense Bunker needs "policing up"
- TDEC field stations 119 & 297: Abandoned drums
- TDEC field station 250: Abandoned & unidentified waste dump (scrap metal, blocks, bricks, etc)
- TDEC field station 313: Tire dump
- TDEC field station 133: Gamma-contaminated site along old road bed overlooking HFIR

Parcel 12: Park City Road Study Area

- None specified

Parcel 13/19: West Haw Ridge/Bearden Creek Watershed Study Area

- TDEC field station 12: Previously unidentified SWMU contaminated with Cs-137
- TDEC field station 89: Previously unidentified SWMU dump (lab equipment, scrap metal, etc)
- TDEC field station 21: Small dump site adjacent to Melton Valley Access Road which is slightly rad-contaminated
- TDEC field stations 50 & 139: Abandoned, empty 55-gallon drums

Parcel 14: Gallaher Bend/Bull Bluff Study Area

- None specified

Parcel 15: Freels Bend Study Area

- TDEC field stations 35 & 36: Existing barns need to be cleared of trash
- TDEC field station 21: Variable Dose Rate Irradiation Facility (VDRIF) facility needs to have shielding blocks removed from the roof of the structure
- TDEC field station 6: Abandoned 55-gallon drum partially submerged in a cove of the Melton Lake
- TDEC field station 21: Demolition debris needs cleaned up & removed
- TDEC field station 52: Trash & debris disposed in large sinkhole
- TDEC field station 23: A small subterranean vault outside the VDRIF facility that held lead source rods; vault reportedly filled with sand; no rad contamination found by TDEC field survey; follow-up sampling?

Parcel 16: Scarboro/East Haw Ridge Study Area

- TDEC field station 6: Anomaly 12 at contaminated trailer
- TDEC field station 7: Building 1404-7 at the location of a radiologically-contaminated hopper

Table 1 Continued

Parcel 20: East Chestnut Ridge Study Area

- TDEC field station 36: Abandoned scrap pile/other refuse along the Brush Burn Access Road
- TDEC field station 38: Abandoned scrap metal/asbestos pile located north of Rogers Quarry
- TDEC field station 39: Abandoned scrap metal pile located north of the Rogers Quarry highwall

Table 2
Appendix C – Site Evaluation Areas

ETTP – K-25 Site

- Powerhouse Knoll Study Area (#21a): 137 acres
- Duct Island Study Area (#21b): 90 acres
- Contractor's Road Study Area (#21c): 57 acres
- Wheat Knoll Study Area (#21d): 180 acres
- Cooper Road Bend
- Perimeter Road Fill Area: 18.9 acres

ORNL – Bethel Valley

- 0900 Firearms Range…RSE in progress
- Abandoned Burn Pit (SWMU # 0.1)
- Compactible Waste Facility Site (SWMU # 0.75)
- Cs-134 Tagged Tree
- Cs-137, Co-60 Contaminated Forest Area
- Freels Bend Study Area (#15): 1,535 acres…Remedial Site Evaluation (RSE) in progress
- Old Bethel Valley Road Dump Site (SWMU # 0.81)
- Walker Branch Study Area (#9): 1,304 acres…RSE planned
- West End Dump Site (SWMU # 0.61)

ORNL – Melton Valley

- Bearden Creek Road Dump Site (SWMU # 8.27)
- Buried Scrap Metal Area (SWMU # 16.3)
- Contaminated Debris Site Adjacent to Building 7819 (SWMU # 7.10)
- Cs-137 Contaminated Meadow
- Cr-51 Contaminated Grass Plots…RSE in preparation – Fall 1998
- Reactive Chemicals Disposal Area (7659B) (SWMU # 19.6)
- Soil Injection of Radioactive Gas (7659C)
- HFIR Drive Disposal Site…proposed inclusion (SWMU # 8.28)

Y-12 National Security Complex – Bear Creek Valley

- East Fork Ridge Knob
- White Wing Scrap Yard - East Creek
- White Wing Scrap Yard – West Creek
- Y-12 Water Treatment Plant Study Area (#4c): 130 acres

Y-12 National Security Complex – Upper East Fork Poplar Creek

- Building 9201-5E Northeast Yard Waste Storage Area
- Building 9202 East Pad Waste Storage Area
- Building 9204-2 West Yard Waste Storage Area
- Building 9215 West Pad Waste Storage Area
- Building 9401-3 East Yard Waste Storage Area

Y-12 National Security Complex – Upper East Fork Poplar Creek (continued)

- Building 9404-11 West Yard Waste Storage Area
- Building 9620-2 West Yard Waste Storage Area
- Building 9720-13 West Yard Waste Storage Area
- Building 9720-3 North Yard Waste Storage Area
- Building 9720-6 North Polytank Station
- Building 9744 North Dock Waste Storage Area
- East Chestnut Ridge Study Area (#20): 1400 acres
- Polytank Station (Building 9206)
- Prenco Incinerator (SWMU # YT-001)
- Tank 2077-U
- Tank 2089-U
- Tank 2090-U
- Tank 2091-U
- Tank 2092-U

Y-12 National Security Complex – Areas outside Watersheds

- Chestnut Ridge Borrow Area Waste Pile (SWMU # YS-042)
- Scarboro Facility Study Area (#17): 82 acres
- Temporary Storage Area (SWMU # YS-126)
- Non-Plant Reservation Groundwater

References

Federal Facility Agreement, January 1992 (with revisions)

Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. *Environmental Restoration Footprint Reduction Process*. Oak Ridge, Tennessee.

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CHAPTER 5 RADIOLOGICAL MONITORING

Ambient Gamma Radiation Monitoring of the Oak Ridge Reservation Using Environmental Dosimetry

Introduction

Gamma radiation is emitted by various radionuclides that have been produced, stored, and disposed on the Oak Ridge Reservation (ORR). Associated radionuclides are evident in ORR facilities and surrounding soils, sediments, and waters. In order to assess the risk posed by these contaminants, the Tennessee Department of Environment and Conservation DOE Oversight Division (the division) began monitoring ambient gamma radiation levels on the ORR in 1995. This program is intended to provide:

- conservative estimates of the potential dose/risk to members of the public from exposure to gamma radiation attributable to DOE activities/facilities on the ORR;
- baseline values used to assess the need/effectiveness of remedial actions;
- information necessary to establish trends in gamma radiation emissions;
- information relative to the unplanned release of radioactive contaminants on the ORR

In this effort, environmental dosimetry is used to measure the radiation dose attributable to external radiation at selected monitoring stations located on and in the vicinity of the Oak Ridge Reservation.

Methods and Materials

Dosimeters used in the program will be obtained from Landauer, Inc., at Glenwood, Illinois. Each of the dosimeters deployed in the program will use aluminum oxide photon detectors to measure the dose from gamma radiation (minimum reporting value = 1 mrem). At locations where there is a potential for the release of neutron radiation, the dosimeters will also contain an allyl diglycol carbonate based neutron detector (minimum reporting value = 10 mrem).

Dosimeters that contain only photon detectors, alone, will be collected quarterly and sent to Landauer for processing. Dosimeters that contain both photon and neutron detectors will be collected and processed semi-annually. To account for exposures that may be received in transit or storage, control dosimeters will be included in each shipment from the Landauer Company. These dosimeters will be stored at the division office and returned to Landauer with the associated field deployed dosimeters for processing. Any exposure received by the control dosimeters will be subtracted from the dose reported for the field deployed dosimeters. At the end of the year, the results will be summed for each location and the resultant annual dose compared to background values and the state/DOE primary dose limit for members of the public (100 mrem/year).

Monitoring stations are chosen to identify sources of external radiation on the ORR, develop conservative estimates of the dose to the public from DOE operations/facilities, and collect information relative to the need and/or effectiveness of remediation. Candidate monitoring stations include: operating facilities; locations on the ORR that are accessible to the public; sites at the perimeter of the reservation near known radiation sources; local communities; and sites subject to or undergoing remediation. Temporary dosimeters may be placed at some locations for short term monitoring. The sites currently monitored in the program are provided in Table 1.

Table 1: Locations of Environmental Dosimeters Deployed on the Oak Ridge Reservation

Station Number (Dosimeter Type)	Location	Station Number (Dosimeter Type)	Location
9. (Photon)	Norris Dam Air Monitoring Station	48.(Photon)	Temp. 1: ETTP K-1420 Building
11.(Photon)	ETTP Grassy Creek Embayment on the Clinch River	51.(Neutron-Photon)	ETTP north side of the K-1066-E UF_6 Cylinder Storage Yard
12.(Neutron-Photon)	ETTP UF_6 Cylinder Yard K-1066-E	53.(Neutron-Photon)	ETTP southwest corner of the K-1066-K UF_6 Cylinder Storage Yard
15.(Photon)	ETTP K-1070-A Burial Ground	53a(Neutron/Photon)	ETTP southwest corner of the K-1066-K UF_6 Cylinder Yard (duplicate)
16.(Photon)	ETTP K-901 Pond	55.(Photon)	Temp. 8: ORNL SWSA 5 Tru Trench
17.(Neutron-Photon)	ETTP K-1066-K UF_6 Cylinder Yard	56.(Photon)	Temp. 9: ORNL Old Hydrofracture Pond
18.(Photon)	ETTP TSCA on fence across from Tank Farm	56a.(Neutron-Photon)	ORNL Old Hydrofracture Pond (duplicate)
20.(Photon)	ORNL Freels Bend Entrance	57.(Photon)	Temp. 10: ETTP UF6 Cylinder Storage Yard K-1066-B
21.(Photon)	ETTP White Wing Scrap Yard	61.(Photon)	Temp. 14: Outer & Illinois Ave
22.(Photon)	ORNL High Flux Isotope Reactor	62. (Photon)	Temp. 15: East Pawley
22a.(Photon)	ORNL High Flux Isotope Reactor (duplicate)	63.(Photon)	Temp. 16: Key Springs Road
23.(Photon)	ORNL Solid Waste Storage Area 5	64.(Photon)	Temp. 17: Cedar Hill Greenway
24.(Photon)	ORNL Building X-7819	65.(Photon)	Temp. 18: California Ave.
25.(Photon)	ORNL Molten Salt Reactor Experiment	66.(Photon)	Temp. 19: Emory Valley Greenway
26.(Photon)	ORNL Cesium Fields	67.(Photon)	Temp. 20: West Vanderbilt
27.(Photon)	ORNL White Oak Creek Weir @ Lagoon Rd	68. (Photon)	White Oak Creek @ Coffer Dam
28.(Photon)	ORNL White Oak Dam	69.(Photon)	ORNL Graphite Reactor
30.(Photon)	ORNL X-3513 Impoundment	70.(Photon)	Scarboro Perimeter Air Monitoring Sta.
31.(Photon)	ORNL @ Cesium Forest boundary	71.(Photon)	Y-12 East Perimeter Air Monitoring Sta.
31a.(Photon)	ORNL @ Cesium Forest boundary (duplicate)	72.(Photon)	ETTP Visitors Center
32.(Photon)	ORNL Cesium Forest on tree	73.(Photon)	Temp. 3: ORNL Spallation Neutron Source (north side)
33.(Photon)	ORNL Cesium Forest Satellite Plot	74.(Photon)	Temp. 4: ORNL Spallation Neutron Source (south side)
34.(Photon)	ORNL SWSA 6 on fence @ Highway 95	75.(Photon)	Temp. 5: ORNL hot spot on Haw Ridge
35.(Photon)	ORNL confluence of White Oak Creek & Melton Branch	78.(Photon)	Temp. 11: ED3 Quarry at Blair Road
38. Photon)	Y-12 Uranium Oxide Storage Vaults	79. (Photon)	Temp.12: ED1 on pole
39.(Photon)	Y-12 @ back side of Walk In Pits	80.(Photon)	Temp.13: Elza Gate
41.(Photon)	ORNL North Tank Farm	81.(Photon)	ORNL visitors center
42.(Photon)	ETTP east side of the K-1401 Building	82.(Photon)	Wag 3
43.(Photon)	ETTP west side of the K-1401 Building	83.(Photon)	Walk in Pit W/ Radon Detector
44.(Photon)	ETTP K-25 Building	84.(Photon)	Temp. 2 Wag 3
45.(Photon)	ETTP K-770 Scrap Yard	85.(Photon)	Background at Ft. Loudoun Dam
46.(Photon)	ORNL Homogeneous Reactor Experiment Site	86.(Neutron-Photon)	Background at Ft. Loudoun Dam
47.(Photon)	Y-12 Bear Creek Road ~ 2800 feet from Clinch River		

References

Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement. Agreement between the U.S. Department of Energy and the state of Tennessee.* Oak Ridge, Tennessee. 2001.

Yard, C.R. 2004. *Health, Safety, and Security Plan*. Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee.

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CHAPTER 5 RADIOLOGICAL MONITORING

Pilot Project for Radon Monitoring

Introduction

The presence of over 40,000,000 pounds of uranium in burial grounds on the Oak Ridge Reservation suggests that radon (a decay product of uranium isotopes) may be present at elevated levels. The Tennessee Department of Environment and Conservation DOE Oversight Division (the division), with the cooperation of DOE and its contractors, proposes to continue a pilot program in 2004 designed to assess the feasibility of monitoring radon at these burial grounds. While the data collected to date is limited to the Bear Creek Burial Grounds (Figure 1), it indicates that radon can be measured using the techniques developed for the project and that the radioactive gas may be elevated over localized areas of the disposal sites.

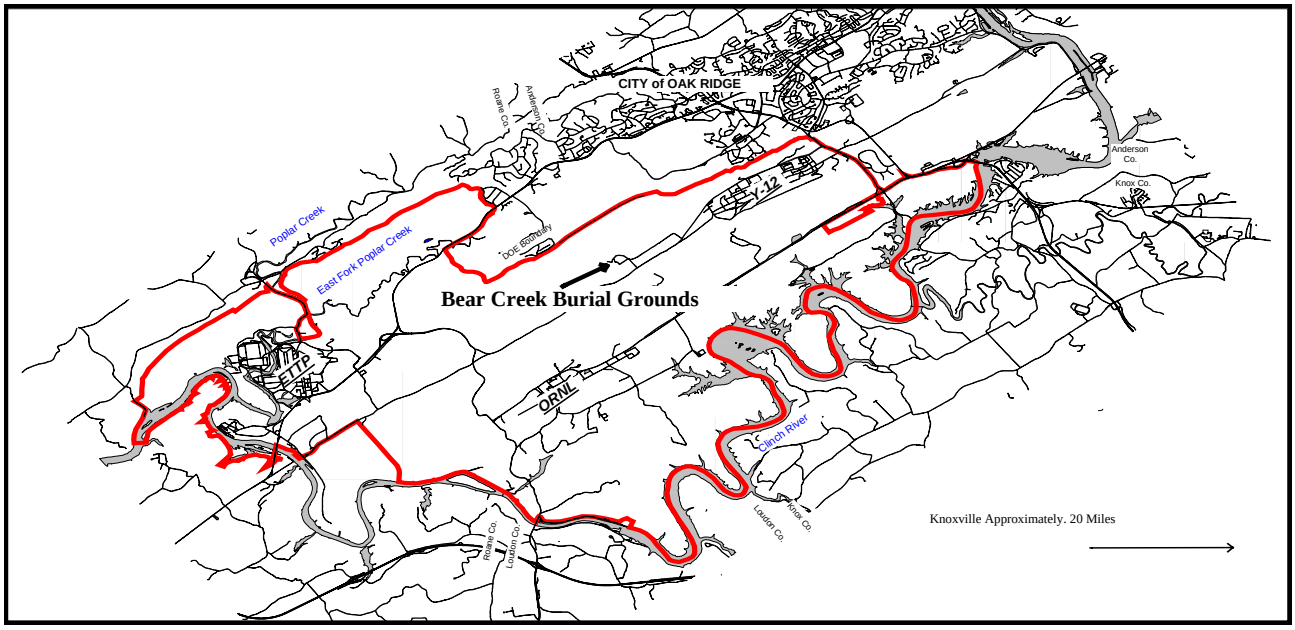

Figure 1: Bear Creek Burial Grounds

Methods and Materials

During late November 2003, twenty-two Radtrak® Radon Gas Detectors were located over the Bear Creek Burial Grounds. Ten additional detectors were placed at background locations in the same geologic formation as the burial grounds. The location of each detector was recorded using the global positioning system (GPS) and a portable GPS receiver. After approximately six months (May 2004), the detectors will be retrieved and shipped to the vendor for processing. Once the data are received, the radon levels measured will be assessed by comparing the results collected over the burial grounds with data from the background locations.

Based on recommendations from the vendor, the detectors were protected from the elements by a housing constructed from five-gallon plastic buckets. Each of the detectors were affixed to the inside bottom of one of these buckets, which were placed inverted at the monitoring station and secured with tent stakes. Ventilation for the detectors was provided by three holes (one-half inch diameter) drilled approximately one-inch above the bottom of each bucket. Figure 2 provides the general configuration of the housing.

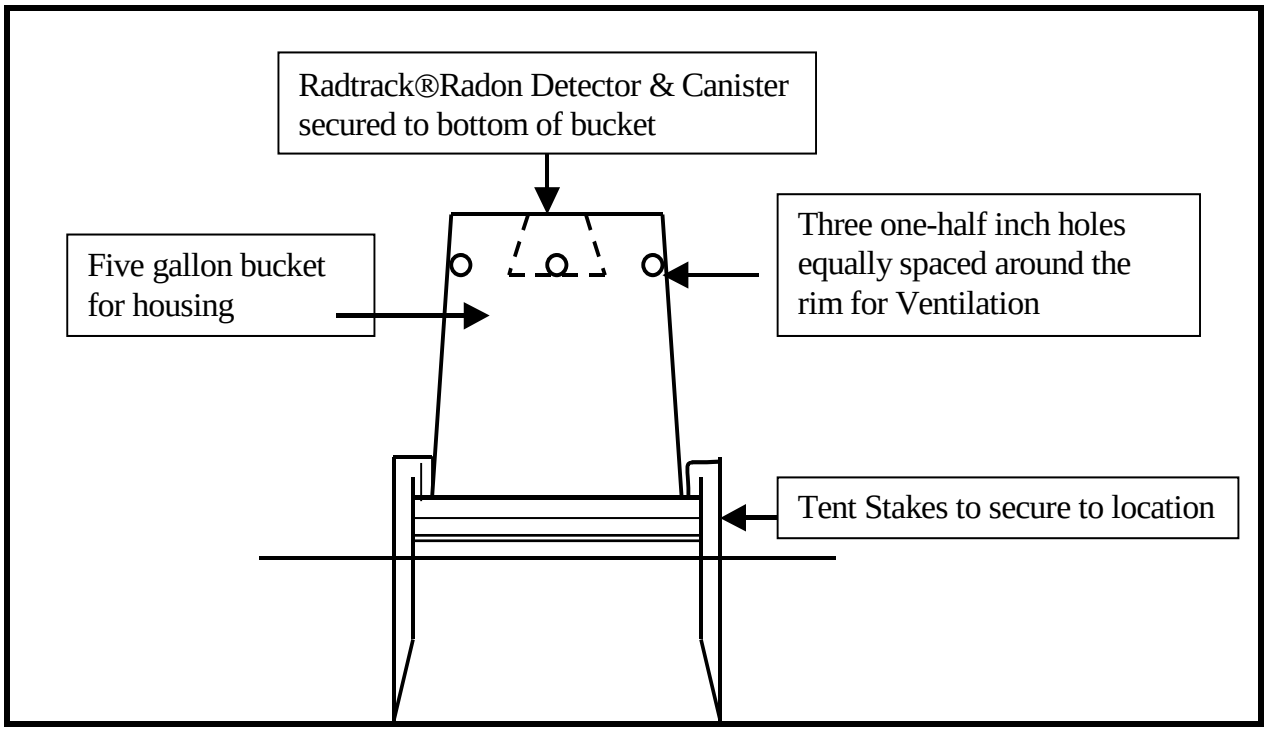

Figure 2: Configuration of Radon Detector Housing (*not to scale*).

References

Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement, Agreement between the U.S. Department of Energy and the state of Tennessee*. Oak Ridge, Tennessee. 2001.

U.S. Environmental Protection Agency, 1992 (revised). *Indoor Radon and Radon Decay Product Measurement Device Protocols.* Office of Air and Radiation (6604J) EPA 402-R-92-004.

Yard, C.R., 2004. *Health, Safety, and Security Plan*. Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee.

CHAPTER 5 RADIOLOGICAL MONITORING

Surplus Material Verification

Introduction

The Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division), in cooperation with the U.S. Department of Energy and its contractors, conducts random radiological surveys of surplus materials that are destined for sale to the public on the Oak Ridge Reservation (ORR). In addition to performing the surveys, the division reviews the procedures used for release of materials under DOE radiological regulations. Also reviewed are any occurrence reports that involve surplus materials. Some materials, such as scrap metal, may be sold to the public under annual sales contracts, whereas other materials are staged at various sites around the ORR awaiting public auction/sale. The division as part of its larger radiological monitoring role on the reservation conducts these surveys to help ensure that no potentially contaminated materials reach the public. In the event that radiological activity is detected, the division will immediately report to the responsible supervisory personnel of the surplus sales program and follow their response to the notification to see that appropriate steps (removal of items from sale, resurveys, etc.) are taken to protect the public.

Methods and Materials

Staff members make random surveys of items that are arranged in sales lots by using standard survey instruments. Potential items range from furniture and computer equipment to vehicles and construction materials. Particular survey attention is paid to smaller equipment and parts. Where "green tags" are attached, radiation clearance information is compared to procedural requirements. If any contamination is detected during the on-site survey, the surplus materials manager for the facility will be notified immediately. In addition to radioactivity, any chemical concerns will be immediately brought to the attention of the manager.

References

Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement. Agreement between the U.S. Department of Energy and the state of Tennessee*. Oak Ridge, Tennessee. 2001.

Yard, C.R. 2004. *Health, Safety, and Security Plan*, Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. Oak Ridge, Tennessee.

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CHAPTER 5 RADIOLOGICAL MONITORING

UF6 Cylinder Transportation Inspection

Introduction

The Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division), in cooperation with the U.S. Department of Energy and its contractors, will conduct routine radiological dose surveys of UF_6 cylinders that are being shipped to the UF_6 conversion facility at Portsmouth, Ohio. DOE plans to ship 500 cylinders this year. Dose rate measurements will be made for the cylinders, trailers with loaded cylinders, and truck cabs after connection to trailers. Standard survey instrumentation will be used for the surveys. Recorded dose rates will be checked for adherence to the Code of Federal Regulations (CFR) for transportation of radiological materials (49 CFR). In addition to dose measurements that are made by the division, evaluation of contractor performed inspections and documentation (contamination surveys, code vessel verifications, vehicle inspections, shipping papers) will be recorded according to the inspection protocol developed by the division. Inspections will be performed for all cylinders for an initial period and then will continue on a random schedule. The division as part of its larger radiological monitoring role on the reservation will conduct these inspections to help ensure that the shipments of radioactive materials meet DOT regulations in protection of the public. Results will be supplied to the Tennessee Emergency Management Agency to support overall shipping decision-making.

Methods and Materials

Staff members will make dose surveys of vehicles loaded with UF_6 cylinders using standard survey instruments. Surveys will be performed on the cylinder, the loaded trailer, and within the occupied space of the cab using a Bicron Microrem. Under trailer measurements will be made using a Ludlum GM probe. Dose measurements will be compared to 49 CFR required limits. Staff will also examine shipping papers, contamination surveys, code vessel inspection, contractor performed dose measurements and contractor performed vehicle inspection reports. The inspection information will be recorded on the Uranium Hexafluoride (UF_6) Cylinder Pre-shipment Inspection Form. If any conditions of non-compliance are observed, immediate notification will be made to the contractor representative responsible for releasing the shipment to the public roadways.

Inspection Procedure for Transportation of UF6 Cylinders

1. Perform instrument checks on BICRON MICRO-REM and Ludlum GM prior to leaving for field. Insure that calibrations are still in date.

2. Upon arrival at ETTP proceed to cylinder staging area (K-1066-F)

3. Contact appropriate personnel for coordination of sampling and required data.

4. Obtain copy of Code Vessel Inspection for each cylinder with signature showing cylinder meets ANSI N14.1 standards (form UCN 9009)

5. Obtain copy of RAD contamination survey for each cylinder. Examine survey to make sure that guidelines are met. (alpha – 220 dpm/100 cm^2 , beta, gamma – 2200 dpm/100 cm^2)

6. Obtain copy of Bill of Lading and any other official shipping papers for cylinder. Check-off appropriate items on checklist.

7. Obtain radiation dose measurements from ETTP RADCON for cylinder, trailer, and cab. Examine to make sure that guidelines are met. (2 mR/hr in cab, 200 mR/hr @ surface and 10 mR/hr @ 1 meter from cylinder, 200 mR/hr @ vertical plane of surface, 200 mR/hr @ lower external surface and 10 mR/hr at 2 meters from vertical plane of trailer).

8. Perform independent radiation dose measurements. Refer to manufacturer instructions for checking HV and Battery readings before survey. Measurement location will be identified on inspection form. Use guidelines listed above for radiation limits. Bicron Microrem will be used for cylinder, vehicle and cab measurements. Ludlum GM will be used for under trailer measurements.

9. Check for presence of shipping papers in proper location (side pocket in door or in seat)

10. Check for presence of emergency guidelines in shipping packet to be carried in cab.

11. . Check for proper placarding on truck (Radioactive 7 and Corrosive 8)

12. Obtain copy of DOT walk-around inspection (or check the inspection form for release of vehicle and obtain hard copy later) (Contractor will inspect each truck.)

Notes: Due to expected shipping schedule, inspections of loaded trailers will be inspected on the day before shipping and inspections of the cabs (including rad measurements and required papers) will be performed on the day of shipping.

Uranium Hexafluoride (UF_6) Cylinder Pre-shipment Inspection Form

Inspection Form No._____

Date_____ Time_____ Shipping Paper No._____

Carrier _____
Address_____
_____Phone_____

Truck Make and No._____ License No._____
Trailer Make and No._____ License No._____

Driver _____
Co-Driver_____

Shipper_____
Address_____
_____Phone_____

General Information

___Yes ___ No Driver (Co-Driver) has CDL with hazardous materials endorsement?[177.816]
___Yes ___ No Shipping papers available and stored in proper location (i.e., side pocket on door or in seat)? [177.817(e)]
___Yes ___ No Emergency Response Information available, adequate, and stored in proper location? [172.602]
___Yes ___ No For fissile material, Type A, has shipper notified consignee of dates of shipment and expected arrival? [173.22(c)] **(Note: For natural or depleted UF_6 enter NA on both the Yes and No lines)**

Shipping Papers

___Yes ___ No Shippers Name listed?
___Yes ___ No Continuation Page identified properly (Page 1 of 2, etc.)? [172.201(c)]
___Yes ___ No Emergency response telephone number listed? [172.201(d)]
___Yes ___ No Proper Shipping Name prescribed for the material listed? [172.202(a)(1) and 172.101 table]
___Yes ___ No UN ID Number listed? [172.202(a)(3)]
___Yes ___ No Total quantity by net or gross mass listed? [172.202(a)(5)]
___Yes ___ No Reportable Quantity (RQ) listed? [172.203(c)(2)]
___Yes ___ No RQ listing required (i.e. does activity present exceed RQ values)? [171.8, Table 2 of Appendix to 172.101]
___Yes ___ No Radionuclides listed on papers [172.203(d)(2)]
___Yes ___ No Description of Chemical and Physical Form? [172.203(d)(3)]
___Yes ___ No Activity listed on papers (In Bequerels or sub/multiples of, and then optionally in Curies or sub/multiples of Curies)? [172.203(d)(4)]
___Yes ___ No Instructions for Exclusive Use vehicles only? [173.441((c)]
___Yes ___ No Shipper's Certification listed and signed? [172.204]

Placarding

___Yes ___ No Placarding required [172.504 and 172.505]

___Yes ___ No Placarding posted on all 4 sides of vehicle (front of truck can be posted in lieu of front of trailer)? [172.504]

___Yes ___ No Type of placarding appropriate?_____ Radioactive 7 _____Corrosive 8 [172.519, 172.556, 172.558]

Package Information

___Yes ___ No Package appropriate for type and activity of radioactive material shipped (ANSI/ASME compliant packaging [173.420(a)(2)(i) and (iii)] and LSA-I [173.427(b)(3)])

___Yes ___ No Certification of ANSI N14.1 compliance available for this package? [173.420]

___Yes ___ No Documentation of Quality Control Tests of package available? [173.474, 173.475, UCN-9009]

___Yes ___ No The scope and results of the Quality Control tests appear adequate? [173.474, 173.475, UCN-9009]

___Yes ___ No Cylinder identification tag properly attached (continuous weld)? [ANSI N14.1]

___Yes ___ No Package securely blocked/braced to prevent shifting during transport? [177.842(d)]

Radiological Information

___Yes ___ No DOE Radiation Survey results for package and vehicle available for this inspection?

___Yes ___ No Radiation levels on surface of package ≤ 200 mR/hr for open bed trailer/transport vehicle and ≤ 1000 mR/hr for closed transport vehicle or open vehicle with personnel barrier under exclusive use? [173.441]

___Yes ___ No Radiation levels at 1 meter (3.2 feet) from the surface of the package ≤ 10 mR/hr ? [173.441]

___Yes ___ No Radiation levels at surface of the closed transport vehicle or at vertical plane of outer edge of open transport vehicle ≤ 200 mR/hr? [173.441]

___Yes ___ No Radiation levels at 2 meters (6.6 feet) from the outer lateral surface of a closed transport vehicle or from the vertical plane of the outer edge of an open transport vehicle (i.e. flat bed type vehicle) ≤ 10 mR/hr [173.441]

___Yes ___ No Radiation levels ≤ 2 mR/hr in any occupied space of the vehicle (i.e. sleeper bay and driver/passenger areas of truck cab)? [173.441]

___Yes ___ No Radiation contamination levels ≤ 220 dpm/100 cm^2 alpha and 2200 dpm/100 cm^2 beta/gamma on surface of package? [173.443]

Note: Refer to DOE contamination survey results for contamination levels (EH-4500/R4 lists areas to survey including valves, plugs and cylinder body). State and/or DOE dose surveys are acceptable for radiation dose levels.

Comments:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Inspector Signature_____ Date_____

_____ Date_____

_____ Date_____

Radiological Surveys

Radiation Level Surveys

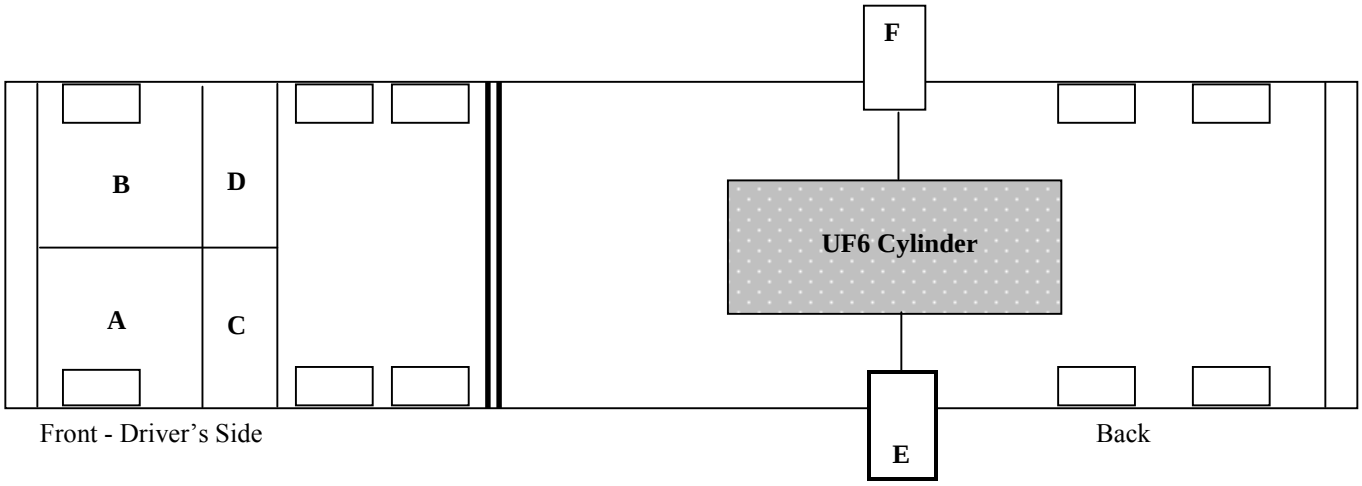
Instrument 1 Used:_____
Serial Number: _____
Calibration Date: _____

Instrument 2 Used:_____
Serial Number: _____
Calibration Date: _____

Instrument 3 Used:_____
Serial Number: _____
Calibration Date: _____

Instrument 4 Used:_____
Serial Number: _____
Calibration Date: _____

Vehicle Location Codes for Surveys



Max. dose rate at edge of (vertical plane) of trailer bed: _____ mR/hr

Max. dose rate on bottom surface of trailer bed: _____mR/hr

Max. dose rate at 2 meters (6.6 feet) from edge (vertical plane) of trailer: _____ mR/hr

Max. dose rate in truck cabin: _____ mR/hr

Package Location Codes for Surveys

J (Right /Passenger Side)

G (Front) **K (Top)** **H (Back)**

I (Left/Drivers Side)

Max. dose rate at surface of package: _____ mR/hr

Max. Dose rate at 1 meter from package: _____ mR/hr

Vehicle Radiological Surveys

Radiation Level Surveys (mR/hr)						
Location Codes	Instrument	Background	Lateral Surface	2- Meter (6.6 feet)	Under Carriage	In Cab
A						
B						
C						
D						
E						
F						

Notes: Undercarriage readings will be measured under cylinder.
Lateral surface is the vertical plane of trailer bed.
2 meter (6.6feet) is from the vertical plane of the trailer bed.

Package Radiological Surveys

Radiation Level Surveys (mR/hr)				
Location Codes	Instrument	Background	Cylinder Surface	1- Meter (3.2feet)
G				
H				
I				
J				
K				

References

Federal Register. *Code of Federal Regulations, 49, Parts 100 to 185, Transportation.* October 1, 2002.

McCall, J.S. 2003. *Inspection Procedure for Transportation of UF_6 Cylinders.* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee.

Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement, Agreement between the U.S. Department of Energy and the state of Tennessee*. Oak Ridge, Tennessee. 2001.

Tennessee Department of Environment and Conservation. *Uranium Hexafluoride (UF_6) Cylinder Pre-shipment Inspection Form.* 2003.

Yard, C.R., 2004. *Health, Safety, and Security Plan,* Tennessee Department of Environment and Conservation, Department of Energy Oversight Division, Oak Ridge, Tennessee.

CHAPTER 6 SURFACE WATER MONITORING

Monitoring of Uranium Transport in Bear Creek Valley

Introduction

A continuation of 2003 monitoring of waters and sediments in Bear Creek Valley is planned to follow the effect of DOE operations on uranium transported by the Bear Creek hydrological system. Surface water, groundwater (springs), and sediment samples will be collected from Bear Creek, springs discharging to Bear Creek, and tributaries of the creek in such a manner that the total flux of uranium being transported by the system can be estimated. These estimates can be used to identify which areas along the creek are the more significant contributors to uranium transport. The data should also provide a baseline against which to measure new sources of contamination and the effectiveness of remedial activities. With the utilization of the Environmental Management Waste Management Facility in Bear Creek Valley and construction of the Spallation Neutron Source facility on Chestnut Ridge, it is planned to add analysis for gamma and selected beta emitting radionuclides for five of the sampling locations that could be impacted by associated activities.

Methods and Materials

To establish the uranium flux from specific areas of Bear Creek Valley, sampling locations were organized into fourteen temporal groups for 2001 sampling. After review of data collected in 2001, this number was reduced to nine groups in 2002 sampling and it is planned to continue with the nine groups for 2004. These groups represent springs, tributaries, and points along Bear Creek that are to be sampled at approximately the same point in time. For example, all locations in group ten are to be sampled on the same day.

Efforts will be made to coordinate this sampling with Y-12 monitoring of wells in order to enable the development of a temporal, three-dimensional model of the uranium flux in the valley. The sampling groups include major springs and tributaries that drain impacted areas of the valley and points along Bear Creek immediately upstream of these springs and tributaries. Monitoring stations and the projected sampling frequency for each site are provided in Table 1. The approximate locations of the sampling sites are depicted in Figure 1.

Table 1: Bear Creek Valley Monitoring Stations

Temporal Groups	Sampling Location (Proposed Sampling Frequency)		
	Springs	Bear Creek	Bear Creek Tributaries
Group 1:	SS-2 (Quarterly)	BCK-11.97 (Quarterly)	NT-3 (Quarterly)
Group 2:		BC @ NT-4 (Quarterly)	NT-4 (Quarterly)
Group 3:	JES Sludge Seep (Quarterly)	BC @ NT-5(Quarterly)	NT-5 (monthly)
Group 4:	*SS-4* (Quarterly)	*BCK-10.60* (Quarterly)	NT-6 (Quarterly)
Group 5:	*SS-5* (Quarterly)	*BCK-09.40* (Quarterly)	
Group 6:		BC @ NT-9 (Once)	NT-9 (Once)
Group 10:	SS-6 (Quarterly)	BC @ SS-6 (Quarterly)	
Group 11:		New Weir (Quarterly)	
Group 14:	SS-7, SS-8 (Quarterly)	*BCK-4.55* (Quarterly)	CRT-4 (Once)

Note: Italicized locations are sampled biannually by DOE. Associated data may be used in lieu of Division sampling.
BC=Bear Creek
BCK=Bear Creek Kilometer
NT=Bear Creek Tributaries draining areas to the north. CRT = Bear Creek tributaries draining areas to the south.

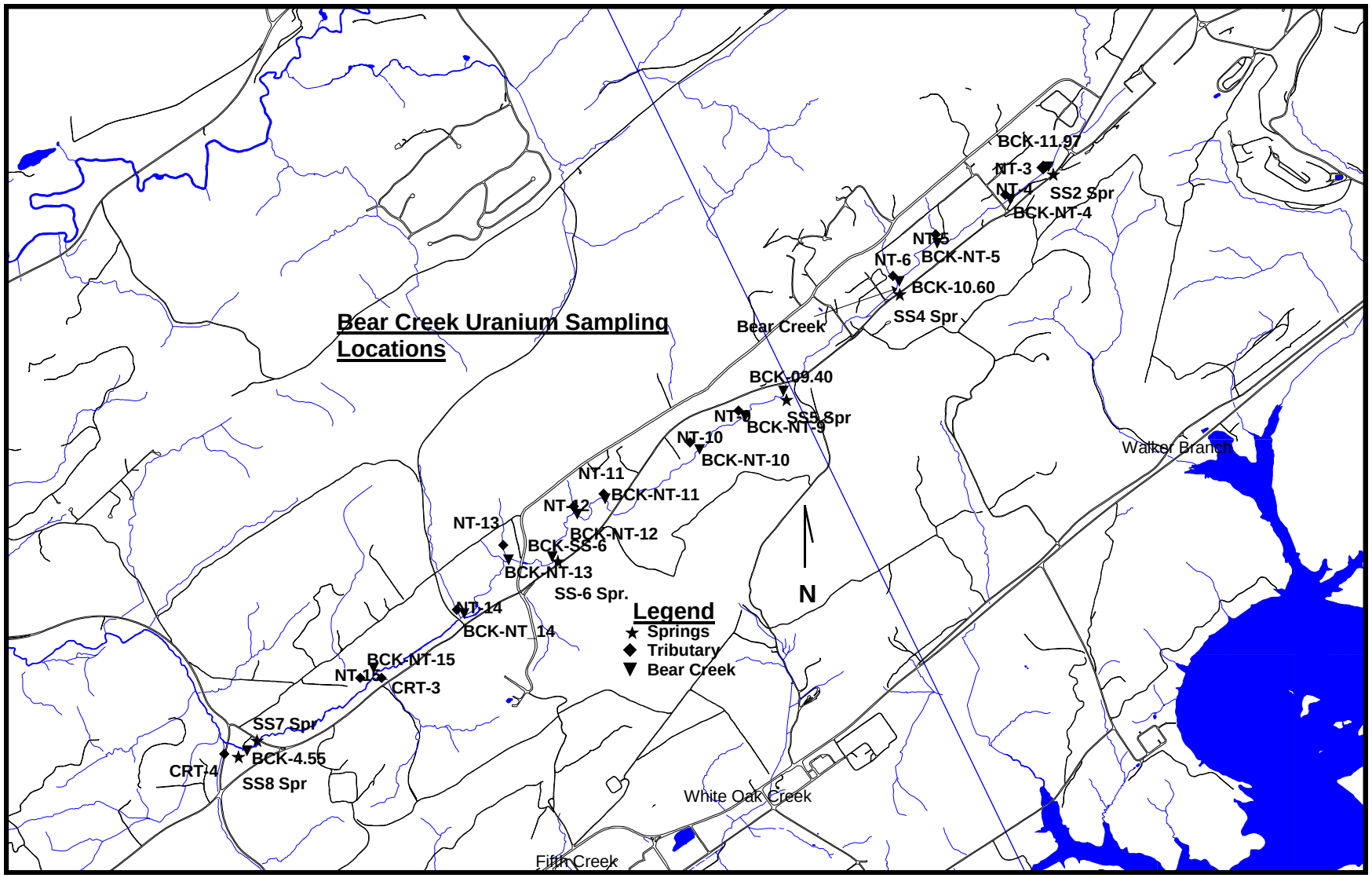


Figure 1: Approximate Location of Bear Creek Valley Water and Sediment Sampling Stations

As noted in Table 1, it is currently planned to sample locations in Groups; 1, 2, 3, 4, 5, 10, 11, and 14 on a quarterly basis. This schedule, along with the media sampled (water/sediments), may be modified to accommodate findings and/or resources. When feasible, results of sampling performed by DOE contractors may be used in lieu of division sampling.

Analysis will include gross alpha, which is assumed to be representative of the uranium burden contained in the waters of Bear Creek Valley. Analysis for uranium isotopes will be preformed on selected samples to confirm that the gross measurement correlates with the uranium concentration. Additional parameters may be added where merited. For example, analysis for iodine-129, Chlorine 36, technetium 99, tritium, carbon-14 and gamma emitters are projected at selected locations (i.e., SS-5, JES Seep, NT-3, NT-4 and NT-5) to assess the affect of waste disposal at the Environmental Management Waste Management Facility. Analysis of gamma emitters will be performed at Bear Creek Kilometer 11.4 to determine EMWMF fission product impact to the creek.

Flow, alkalinity, temperature, and conductivity measurements (if instrumentation is available) will be taken at each sampling station prior to collecting the sample. Existing weirs will be utilized for the flow measurement where available. If weirs are not available, flow will be calculated based on estimates of the velocity, width, and depth of the stream.

Sampling will be conducted following protocol specified in Section 4.8 of the US Environmental Protection Agency Region IV Environmental Services Division's *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual* (EPA 1991). The samples will be collected in containers specified by the state laboratory for the media and parameter to be analyzed. Necessary instrumentation will be calibrated prior to leaving for the field. The chain of custody and custody seals (as appropriate) will be prepared at the time of sampling.

References

AJA Technical Services Inc. *Y-12 Plant Groundwater Protection Program Groundwater and Surface Water Sampling and Analysis Plan for Calendar Year 2001*. Oak Ridge, Tennessee.

Hatcher, et al. *Status Report on the Geology of the Oak Ridge Reservation*. Environmental Sciences Division. Oak Ridge, Tennessee. 1992. Pub No. 3860 (ORNL/TM-12074).

Tennessee Department of Environment and Conservation. *Tennessee Oversight Agreement. Agreement between the U.S. Department of Energy and the state of Tennessee*. Oak Ridge, Tennessee. 2001.

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CHAPTER 6 SURFACE WATER MONITORING

Rain Event Surface Water Monitoring

Introduction

Due to the presence of areas of extensive point and non-point source contamination on the Oak Ridge Reservation (ORR), there exists the potential for contamination to impact surface waters on the ORR during excessive rain events. These events could cause the displacement of contamination that would not normally impact streams around the ORR.

To assess the degree of surface water impact caused by these rain events, a sampling of streams will be conducted following heavy rain events to determine the presence or absence of contaminants of concern. Table 1 shows locations that have been selected for sampling.

Table 1. Sample Locations

Site	Location
EFK 23.4	Station 17
WCK 3.0	White Oak Creek at Lagoon Road
MEK 0.1	Melton Branch Weir
MIK 0.1	Mitchell Branch Weir
BCK 4.5	Bear Creek Weir at Hwy. 95
MBK 1.6	Mill Branch (Reference)

Methods and Materials

In addition to temperature, pH, and conductivity, the following parameters will be analyzed for:

Inorganics: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, nitrogen (NO_2 & NO_3), ammonia, nitrogen (total Kjeldahl), total phosphates.

Other tests: E. coli, Enterococcus, dissolved residue, suspended residue, and total hardness.

Radionuclides: Gross alpha, gross beta, gamma radionuclides.

Schedule

The monitoring will be conducted no more than once per quarter following either a 1" rain event in a 24 hour period or a 2" rain event over a 72-hour period.

Standard Operating Procedures

Special care must be taken when sampling water in which contaminants can be detected in the parts per billion and/or parts per trillion range. In order to prevent cross-contamination of these samples, the following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, non-powdered, disposable latex or vinyl gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

- Sample containers for source samples or samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, tagging, etc.

- If possible, ambient samples and source samples should be collected by different field teams. If different field teams cannot be used, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants should be lined with new, clean, plastic bags.

- If possible, one member of the field sampling team should take all the notes, fill out tags, etc., while the other members collect the samples.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

- Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned for collection of samples for trace metals or organic compound analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern.

Sample Handling

After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that melted ice cannot cause the sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as Zip-Lock® bags or similar plastic bags sealed with tape, should be used when small sample containers (e.g., VOC vials or bacterial samples) are placed in ice chests to prevent cross-contamination.

Laboratory Procedures

The Tennessee Department of Health, Environmental Laboratory and Microbiological Laboratory Organization (Laboratory Services) has expertise in a broad scope of services and analysis available to the Tennessee Department of Environment and Conservation Department of Energy Oversight Division (the division) and other TDEC divisions statewide. General sampling and analysis methods are to follow Environmental Protection Agency (EPA) guidelines as listed in appropriate parts of 40 Code of Federal Regulations (CFR). Certain analyses and QC samples may be subcontracted out by Laboratory Services to independent laboratories. Bench level

Quality Assurance/Quality Control (QA/QC) records and chain-of-custody records are maintained at the Tennessee Environmental Laboratory as are QA records on subcontracted samples.

The division will use primarily the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will generally be analyzed in Knoxville while organics samples will be sent on to the Central Laboratory in Nashville. All laboratory analysis will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for the Tennessee Laboratory Services Division. The SOPs direct analysts to the proper EPA or other methodology.

References

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CHAPTER 6 SURFACE WATER MONITORING

Ambient Sediment Monitoring Program

Introduction

Sediment samples are collected annually at sites (Table 1) on the Tennessee River, the Clinch River and some of its tributaries. The sediment samples are analyzed for organics, metals, and radiological contamination in order to assess the sediment quality for public health and ecological considerations.

The objective of this monitoring program is to assess the degree of sediment pollution of the Tennessee River, Clinch River and its tributaries.

Table 1: Sample Locations

Site	Location	Clinch River Mile
2	Anderson County Water Treatment Plant	52.6
3	Downstream Williams Bend	35.5
4	Grubb Islands	17.9
5	Brashear's Island	10.1
6	Bull Run Steam Plant	48.7
7	Water Treatment Plant	41.2
8	Scarboro Creek	41.2*
9	Kerr Hollow Branch	41.2*
10	McCoy Branch	37.5*
11	Western Branch	37.5*
12	East Fork Walker Branch	33.2*
13	Bearden Creek	31.8*
17	Unnamed stream	20.0*
18	Raccoon Creek	19.5*
19	Ish Creek	19.1*
20	Grassy Creek	14.55*
21	Unnamed stream	14.55*
22	Unnamed stream	14.45*
23	Unnamed stream north of Pilot Knob and south of Warehouse Road	51.1*
24	White Creek	102.4*
25	Clear Creek	78.2*
26	Clinch River	9.0
27	Clinch River	7.0
28	Clinch River	4.0
29	Tennessee River at confluence of Clinch River	0.0
32	Clinch River Mile 19.7	19.7
33	Poplar Creek Mile 0.5	n.a.
34	Walker Branch	33.2*
35	Unnamed stream	18.7*

*These samples will be collected at a point on the tributary upstream of the river far enough to get a sediment and water sample that would be characteristic of the tributary and not be affected by the high flow of the river.

Methods and Materials

Parameters to be analyzed

Inorganics: aluminum, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, and zinc

Organics (extractables): butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, di-n-octylphthalate, diethylphthalate, dimethylphthalate, n-nitrosodimethylamine, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, isophorone, nitrobenzene, 2,4-dinitrotoluene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene, bis(2-chloroethyl) ether, bis(2-chloroethoxy)methane, bis(2-chloroisopropyl) ether, 4-bromophenylphenyl ether, 4-chlorophenylphenylether, hexachlorocyclopentadiene, hexachlorobutadiene, hexachlorobenzene, hexachloroethane, 1,2,4-trichlorobenzene, 2-chloronapthalene, 4-chloro-3-methyl phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 4,6-dinitro-o-cresol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, phenol, 2,4,6-trichlorophenol

Organics (pesticides/PCBs): aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (lindane), technical chlordane, alpha-chlordane, gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, dieldrin, endosulfan I, endosulfan II, endosulfan sulfate, endrin, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, toxaphene, methoxychlor, PCB 1016/1242, PCB 1221, PCB 1232, PCB 1248, PCB 1254, PCB 1260, PCB 1262

Radiological: gross alpha (total), gross beta (total), gross gamma (total), *gamma radionuclides:* ^{137}Cs, ^{40}K, ^{214}Pb, ^{214}Bi, ^{212}Pb, ^{228}Ac, ^{208}Tl, ^{212}Bi and others as detected.

Schedule

The ambient sediment monitoring will be conducted in the second quarter of 2004.

Sediment Standard Operating Procedures

Sediment analysis is a key component of environmental quality and impact assessment for rivers, streams, lakes, and impoundments. Samples can be collected for a variety of chemical, physical, toxicological and biological investigations. This procedure is to be used to obtain quality assured sediment sampling. The resulting data may be qualitative or quantitative in nature and is appropriate for use in preliminary surveys as well as confirmatory sampling.

Required Equipment

sampling platform/boat
depth finder
stainless steel petite ponar grab sampler
stainless steel mixing bowl
stainless steel spoon
pressurized water sprayer
deionized water
rubber gloves
aluminum foil
sample jars
sample labels
cooler/ice packs
scrubber
lab sheets
chain-of-custody forms
field notebook

Procedure

If the water is wadeable, one can collect a sediment sample by scooping the sediment using a stainless steel spoon or scoop. This can be accomplished by wading into the stream, and while facing upstream, scooping the sample along the stream bottom in the upstream direction. If one is sampling a deep lake or impoundment, one can use the Petite Ponar dredge to obtain a sample. Step by step directions are as follows:

Sediment sampling in wadeable streams and rivers:

1. Locate suitable sampling site. Remember that a site immediately downstream of a riffle area has the greatest amount of deposition since the velocity of the stream slows down. Beware of constrictions in the stream where scouring may be occurring.
2. Don rubber gloves to avoid self-contamination during sampling.
3. Using decontaminated stainless steel spoon, obtain sediment sample by scraping the streambed in the upstream direction.
4. Place three samples scoops in a stainless steel bowl and mix thoroughly to obtain a homogeneous sample.
5. Have sediment samples surveyed by Radiological Monitoring.
6. Carefully transfer sample into the appropriate containers as stated by the state of Tennessee Labs.
7. Record all pertinent information on lab sheets, sample labels, and make necessary entries into field notebook.
8. Place all samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4 C by using ice or freezer packs.
9. Rinse all equipment using scrubber brush and sprayer filled with deionized water.
10. Deliver sediment samples to state lab within appropriate holding time frames, and sign chain-of-custody forms.

Sediment sampling in lakes or reservoirs using Petite Ponar dredge:

1. Don rubber gloves to avoid self-contamination during sediment sampling.
2. Place stabilizing pin into arm attachments to lock dredge jaws in open position.
3. Using dredge cable, carefully lower dredge through water column. Slow the descent just prior to contact with sediment to prevent any disturbance to the sediment.
4. As the dredge contacts the sediment, allow the line to go slack, which in turn releases the stabilizing pin.
5. Give a quick tug to the cable, this enables the dredge jaws to close. Carefully pull the dredge through the water column.
6. Obtain three sediment samples this way and place each of them into a stainless steel bowl.
7. Using a stainless steel spoon, thoroughly mix the sediment to obtain a homogeneous composite.
8. Have sediment sample surveyed by Radiological Monitoring.
9. Carefully transfer the collected sediment into appropriate sampling jars as stated by the state of Tennessee Labs.

10. Record all pertinent information on lab sheets, samples labels, and make necessary entries into field notebook.
11. Place sediment samples into cooler as soon as possible. Temperature within the cooler should be maintained at 4 C by using ice or freezer packs.
12. Rinse all equipment using scrubber brush and sprayer filled with deionized water.
13. Deliver samples to state lab within appropriate time frames. Be sure to sign all chain-of-custody forms.

Laboratory Procedures

The Tennessee Department of Health, Environmental Laboratory and Microbiological Laboratory Organization (Laboratory Services) has expertise in a broad scope of services and analysis available to the Tennessee Department of Environment and Conservation (TDEC) Department of Energy Oversight (DOE-O) and other TDEC divisions statewide. General sampling and analysis methods are to follow Environmental Protection Agency (EPA) guidelines as listed in appropriate parts of 40 Code of Federal Regulations (CFR). Certain analyses and QC samples may be subcontracted out by Laboratory Services to independent laboratories. Bench level Quality Assurance/Quality Control (QA/QC) records and chain-of-custody records are maintained at the Tennessee Environmental Laboratory as are QA records on subcontracted samples.

DOE-O will primarily use the Knoxville branch of Laboratory Services. Wet chemistry and metals samples will generally be analyzed in Knoxville while organics samples will be sent on to the Central Laboratory in Nashville. All laboratory analysis will follow appropriate methods as documented in the Laboratory Services Inorganic Chemistry SOP and Organic Chemistry SOP. Specific analytical methods are covered in the Standard Operating Procedures (SOP) manuals for the Tennessee Laboratory Services Division. The SOPs direct analysts to the proper EPA or other methodology.

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CHAPTER 6 SURFACE WATER MONITORING

Ambient Surface Water Monitoring Program

Introduction

Surface water sampling is conducted twice a year at 26 sites (Table 1) located on the Clinch River and it's tributaries. The surface water samples are analyzed for metals, nutrients and other parameters in order to assess the water quality for public health and ecological considerations. Sampling sites 1, 2, 24, and 25 are background data collection sites and are located upstream of the Oak Ridge Reservation (ORR). The other sites were chosen to detect contaminants being transported by surface water or stormwater coming from the ORR or areas affected by Department of Energy (DOE) related activities.

To assess the degree of surface water pollution of the Clinch River and its tributaries, the sites will be sampled semiannually. The water samples will be analyzed for certain inorganic (metallic and non-metallic) materials, environmental microbiological attributes, and some physical characteristics.

Table 1: Sample Locations

Site	Location	Clinch River Mile
1	Downstream of Norris Dam, Clinch River	78.7
2	Anderson County Water Treatment Plant	52.6
3	Downstream of Williams Bend	35.5
4	Grubb Islands	17.9
5	Brashear's Island	10.1
6	Bull Run Steam Plant	48.7
7	Water Treatment Plant	41.2
8	Scarboro Creek	41.2*
9	Kerr Hollow Branch	41.2*
10	McCoy Branch	37.5*
11	Unnamed Stream	37.5*
12	East Fork Walker Branch	33.2*
13	Bearden Creek	31.8*
17	Unnamed Stream	20.0*
18	Raccoon Creek	19.5*
19	Ish Creek	19.1*
20	Grassy Creek	14.55*
21	Unnamed Stream	14.55*
22	Unnamed Stream	14.45*
23	Unnamed Stream south of Warehouse Rd.	51.1*
24	White Creek	102.4*
25	Clear Creek	77.7*
32	Clinch River Mile 19.7	19.7
33	Poplar Creek Mile 0.5	12.0
34	Walker Branch	33.2*
35	Unnamed Stream	18.7*

*These samples will be collected at a point on the tributary upstream of the river far enough to get a water sample that would be characteristic of the tributary and not be affected by the high flow of the river.

Methods and Materials

Parameters to be analyzed

Inorganics: arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, nitrogen (NO_2 & NO_3), ammonia, nitrogen (total Kjeldahl), total phosphorus.

Other tests: E. coli, Enterococcus, COD, dissolved residue, suspended residue, total hardness.

Schedule

The ambient water monitoring will be conducted in the second and fourth quarters.

Standard Operating Procedures

Special care must be taken when sampling water in which contaminants can be detected in the parts per billion and/or parts per trillion range. In order to prevent cross-contamination of these samples, the following precautions shall be taken when trace contaminants are of concern:

- A clean pair of new, non-powdered, disposable vinyl gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

- Sample containers for source samples or samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, tagging, etc.

- If possible, ambient samples and source samples should be collected by different field teams. If different field teams cannot be used, all ambient samples shall be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples shall never be placed in the same ice chest as environmental samples. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants should be lined with new, clean, plastic bags.

- If possible, one member of the field sampling team should take all the notes, fill out tags, etc., while the other members collect the samples.

- When sampling surface waters, the water sample should always be collected before the sediment sample is collected.

- Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

- Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned for collection of samples for trace metals or organic compounds analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC shall not be used to collect samples for trace organic compounds analyses.

Sample Handling

After collection, all sample handling should be minimized. Investigators should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, investigators should ensure that melted ice can not cause the sample containers to become submerged, as this may result in sample cross-contamination. Plastic bags, such as Zip-Lock® bags or similar plastic bags sealed with tape, should be used when small sample containers (e.g., VOC vials or bacterial samples) are placed in ice chests to prevent cross-contamination.

Laboratory Procedures

The Tennessee Department of Health, Environmental Laboratory and Microbiological Laboratory Organization (Laboratory Services) has expertise in a broad scope of services and analysis available to the Tennessee Department of Environment and Conservation (TDEC) Department of Energy Oversight (DOE-O) and other TDEC divisions statewide. General sampling and analysis methods are to follow Environmental Protection Agency (EPA) guidelines as listed in appropriate parts of 40 Code of Federal Regulations (CFR). Certain analyses and QC samples may be subcontracted out by Laboratory Services to independent laboratories. Bench level Quality Assurance/Quality Control (QA/QC) records and chain-of-custody records are maintained at the Tennessee Environmental Laboratory as are QA records on subcontracted samples.

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